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NATIONAL DAM SAFETY PROGRAM. HOPE LAKE DAM (NJ 00796) DELAWARE --ETC(U)
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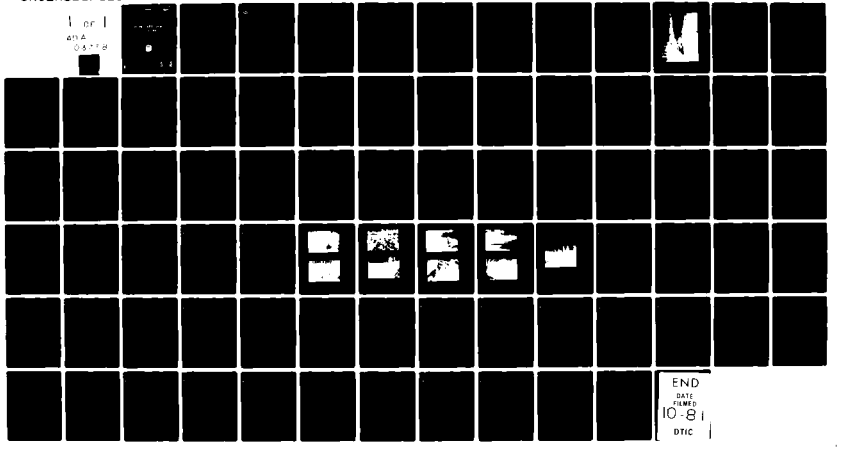

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DELAWARE RIVER BASIN
BEAVER BROOK, WARREN COUNTY
NEW JERSEY

HOPE LAKE DAM
NJ 00796

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

AUGUST 1981

REPT #: DAEN/NAP - 53842/NJ00796 - 81/08

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

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7. AUTHOR(s): Guinan, Warren, P.E.	8. CONTRACT OR GRANT NUMBER(s): DACW61-79-C-0011
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Anderson-Nichols 150 Causeway St. Boston, Massachusetts 02114	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: Warren A. Guinan
11. CONTROLLING OFFICE NAME AND ADDRESS: NJ Department of Environmental Protection Division of Water Resources P.O. Box CN029 Trenton, NJ 08625	12. REPORT DATE: August 1981
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18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams
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Visual Inspection
Structural Analysis
National Dam Safety Program
Hope Lake Dam, N.J.
Seepage
Spillways
Erosion

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report. → Rev. 1

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-N

21 AUG 1981

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Hope Lake Dam in Warren County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Hope Lake Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in very poor overall condition. The dam's spillways are considered inadequate because a flow equivalent to 5 percent of the Spillway Design Flood (SDF) would cause the dam to be overtopped. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures and studies within six months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated. In the interim, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. Within three months from the date of approval of this report the owner should engage a qualified professional consultant to perform the following:

(1) Investigate the cause of the seepage and wet, soft areas at the downstream toe of the dam.

(2) Design procedures for and inspect the removal of the trees and their roots from the entire embankment.

(3) Design procedures for and inspect the construction of erosion protection on the upstream slope of the dam.

(4) Design procedures for the repair or replacement of the gated and ungated spillways where considerable erosion and seepage are taking place.

(5) Design channels to reroute the flowing water away from the toe of the dam.

(6) Establish procedures and supervise backfilling of the embankment sections on either side of the stoplog spillway.

c. Within one year from the date of approval of this report the owner should engage a qualified professional consultant to design and supervise installation of adequate means to drain the reservoir in case of emergency.

d. Within thirty days from the date of approval of this report the following remedial actions should be initiated:

(1) Clear debris and trees from the spillway discharge channels and maintain the channels free from debris.

(2) Clear brush and uncontrolled vegetation from slopes of the dam and keep the slopes free from all debris.

(3) Clear trees and brush for some distance downstream from the toe of the dam and from the banks of the discharge channels for some distance downstream from the spillways.

e. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam, within one year from the date of approval of this report.

f. An emergency action plan and warning system should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within six months from the date of approval of this report.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

NAPEN-N
Honorable Brendan T. Byrne

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

ROGER L. BALDWIN
Lieutenant Colonel, Corps of Engineers
Commander and District Engineer

1 Incl
As stated

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

HOPE LAKE DAM (NJ00796)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 21 April 1981 by Anderson-Nichols and Co. Inc., under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Hope Lake Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in very poor overall condition. The dam's spillways are considered inadequate because a flow equivalent to 5 percent of the Spillway Design Flood (SDF) would cause the dam to be overtopped. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures and studies within six months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated. In the interim, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. Within three months from the date of approval of this report the owner should engage a qualified professional consultant to perform the following:

(1) Investigate the cause of the seepage and wet, soft areas at the downstream toe of the dam.

(2) Design procedures for and inspect the removal of the trees and their roots from the entire embankment.

(3) Design procedures for and inspect the construction of erosion protection on the upstream slope of the dam.

(4) Design procedures for the repair or replacement of the gated and ungated spillways where considerable erosion and seepage are taking place.

(5) Design channels to reroute the flowing water away from the toe of the dam.

(6) Establish procedures and supervise backfilling of the embankment sections on either side of the stoplog spillway.

c. Within one year from the date of approval of this report the owner should engage a qualified professional consultant to design and supervise installation of adequate means to drain the reservoir in case of emergency.

d. Within thirty days from the date of approval of this report the following remedial actions should be initiated:

(1) Clear debris and trees from the spillway discharge channels and maintain the channels free from debris.

(2) Clear brush and uncontrolled vegetation from slopes of the dam and keep the slopes free from all debris.

(3) Clear trees and brush for some distance downstream from the toe of the dam and from the banks of the discharge channels for some distance downstream from the spillways.

e. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam, within one year from the date of approval of this report.

f. An emergency action plan and warning system should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within six months from the date of approval of this report.

APPROVED: Roger L. Baldwin

ROGER L. BALDWIN
Lieutenant Colonel, Corps of Engineers
Commander and District Engineer

DATE: 21 Aug 81

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Hope Lake
Identification No.:	Fed ID No. NJ00796
State Located:	New Jersey
County Located:	Warren
Stream:	Beaver Brook
River Basin:	Delaware
Date of Inspection	April 21, 1981

ASSESSMENT OF GENERAL CONDITIONS

Hope Lake Dam is an earthfill, stone masonry, and concrete dam, about 200 years old, that is in poor overall condition. It is small in size and should be downgraded to significant hazard from its initial classification of high hazard. Trees and brush are growing on both upstream and downstream slopes of the earth embankment portions of the dam. One large tree has blown down causing a large hole in the downstream embankment where the roots were torn out near the left abutment of the principal spillway. Severe erosion of the embankments on either side of the stoplog spillway has undermined the concrete capping and exposed the concrete and stone masonry of the training walls. Much of the downstream stone masonry face under the concrete apron of the emergency spillway has collapsed leaving the slab unsupported. Erosion of the upstream slope at and above the waterline has occurred. Soft, wet areas were noted along the downstream toe of the embankment portions with some clear water discharges. The left abutment of the principal spillway has been patched; yet some leakage was noted below the patch. Leakage around the ends and through the stoplogs was observed. Also, seepage is occurring through the upstream concrete or stone masonry faces at both the stoplog and emergency spillways. The total combined capacities of the principal, emergency, and stoplog spillways (with stoplogs in place) can pass 4 percent of the one-half PMF without overtopping; thus the spillways are considered inadequate.

It is recommended that the owner retain the services of a professional engineer, qualified in the design and inspection of dams, to accomplish the following in the time periods specified. Starting immediately: investigate the cause of the seepage and wet, soft areas at the downstream toe of the dam; very soon: design procedures for and inspect the removal of the trees and their roots from the entire embankment; design procedures for and inspect the construction of erosion

protection on the upstream slope of the dam; design procedures for the repair or replacement of the gated and ungated spillways where considerable erosion and seepage are taking place; design channels to reroute the flowing water away from the toe of the dam; and establish procedures and supervise backfilling of the embankment sections on either side of the stoplog spillway. In the near future: further evaluate the hydrology and hydraulics of the watershed, reservior, dam, spillways, and design and implement remedial measures; and design and install adequate means to drain the reservoir in case of emergency.

It is also recommended that, as a part of operating and maintenance procedures, the owner should immediately clear debris and trees from the spillway discharge channels and maintain the channels free from debris, check the condition of the dam periodically; clear brush and uncontrolled vegetation from slopes of the dam and keep the slopes free from all debris, and clear trees and brush for some distance downstream from the toe of the dam and from the banks of the discharge channels for some distance downstream from the spillways. In addition, in the future: establish a surveillance program for use during and immediately following periods of heavy rainfall and also a warning program to follow in case of emergency conditions.

ANDERSON-NICHOLS & COMPANY, INC.

Warren A. Guinan

Warren A. Guinan, P.E.
Project Manager
New Jersey No. 16848

21 April 1981

OVERVIEW

HOPE LAKE DAM

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonable possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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PHASE I INSPECTION REPORT
HOPE DAM SAFETY REPORT

HOPE LAKE DAM FED ID NO. NJ00796

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION PROGRAM
HOPE LAKE DAM
FED ID NO. #NJ00796

SECTION 1
PROJECT INFORMATION

5.1 General

a. Authority. Authority to perform the Phase I Safety Inspection of Hope Lake Dam was received from the State of New Jersey, Department of Environmental Protection, Division of Water Resources by letter dated 12 December 1980 under Basic Contract No. FPM-39 and Contract No. A01093 dated 10 October 1979. This Authority was given pursuant to the National Dam Inspection Act, Public Law 92-367 and by agreement between the State and the U.S. Army Engineers District, Philadelphia. The inspection discussed herein was performed by Anderson-Nichols & Company, Inc.

b. Purpose: The purpose of the Phase I Investigation is to develop an assessment of the general conditions with respect to the safety of Hope Lake Dam and appurtenances. Conclusions are based upon available data and visual inspection. The results of this study are used to determine any need for emergency measures and conclude if additional studies, investigations, and analyses are necessary and warranted.

1.2 Project Description

a. Description of Dam and Appurtenances. Hope Lake Dam is a 233-foot long 8.6-foot high earthfill, stone masonry, and concrete structure. The dam crest is approximately 12.5 feet wide with 2.5H:1V slope brush covered earthen embankment on the upstream side. The downstream embankment at Hope Lake Dam is tree covered with a 2H:1V slope. The dam crest is grass covered with small trees growing on it as well. The concrete capped, stone masonry principal spillway is located on the right side of the dam and is 60 feet long and 2 feet wide. A stoplog section is located approximately in the middle of the dam and consists of four 4"x 8" planks placed in a 4'x 4' bay. The concrete capped, stone masonry emergency spillway is located near the left abutment and is 52.4 feet long with a crest width of about 8 inches, it has a concrete slab apron upstream and a 6.5 foot downstream apron. At the end of the left abutment there is a small canal that is about 9 feet wide at the inlet, that formerly used to supply water power for a mill about a quarter mile downstream.

b. Location. Hope Lake Dam is located on Beaver Brook in Hope Township, Warren County, New Jersey. The Dam is at 40° 54.5' north latitude 74° 58.0' west longitude on the Blairstown Quadrangle. A location map has been included as Figure 2. The dam can be reached by taking exit 12 off Rt. 80 west, onto Rt. 521 south. The dam is on the left a mile from the Rt. 521 exit.

c. Size Classification. Hope Lake Dam is classified as being small in size on the basis of storage at the top of dam of 100 acre-feet, which is less than 1000 acre-feet but more than 50 acre-feet, and on the basis of its structural height of 8.8 feet, which is less than 40 feet, in accordance with criteria given in the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. Visual inspection of the area below Hope Lake Dam indicated that a single house of about 0.1 mile downstream on the left bank could have up to 6 feet of flood water in the garage beneath the house from either overtopping or breaching of the dam. About two feet of overtopping of the road crossings downstream of the house, would likely result in considerable property damage and possible loss of life. For these reasons, the dam is given a significant hazard classification.

e. Ownership. The dam is owned by Mr. & Mrs. Charles Southwick, P.O. Box 282, Milbrook Road, Hope, New Jersey; for information they may be reached at the above address.

f. Purpose. The original purpose of Hope Lake Dam was to generate power for the downstream mill; recreation is its present purpose.

g. Design and Construction History. No information regarding the original plan or design of the dam was available. Mrs. Southwick said that the dam was originally built by Moravians about 1769. The mill race was dug out by hand using adzes.

h. Normal Operational Procedure. No operational procedures exist for the dam.

i. Site Geology. No site specific geologic information (such as borings) was available at the time the dam was inspected. Information derived from the Geologic Map of New Jersey (Lewis and Kummel, 1912) and Glacial Drift Map of New Jersey (Kummel and Peet, 1902) indicates that the soils within the immediate site area consist of stratified glacial deposits in the form of sands and gravels, deltas, eskers, kames, and terraces.

The depth to bedrock at the dam site is unknown. From the reports previously mentioned, bedrock in this area consists of massive to thin bedded limestones which are Cambrian to Ordovician in age. However, bedrock exposure in the 16-foot cut for the mill race is a dark, fissile, steeply dipping shale. This exposure is about 200 feet downstream of the dam.

1.3 Pertinent Data

a. Drainage Area

7.7 square miles

b. Discharge at Damsite (cfs)

Maximum flood at damsite - unknown.

Total ungated spillway capacity at maximum elevation - 337 (with stoplogs in place)

c. Elevation (ft. above NGVD)

Top of dam - 426.0

Maximum pool design surcharge (1/2 PMF) - 430.3

Recreation pool (at time of inspection) - 424.9

Spillway crest - 424.7

Streambed at centerline of principal spillway - 420.4

Maximum tailwater (estimated) - 422.8
(10 ft downstream of dam)

d. Reservoir (feet)

Length of maximum pool - 2600 (estimated)

Spillway crest - 1800

e. Storage (acre-feet)

Spillway crest - 64

Design surcharge (1/2 PMF) - 725

Top of dam - 100

f. Reservoir Surface (acres)

Top of dam - 25 (estimated)

Spillway crest - 12.8

g. Dam

Type - earthfill, stone masonry, and concrete

Length - 233 feet

Height - 8.6 feet (hydraulic)

- 8.8 feet (structural)

Top width - 12.5 feet

Side slopes - upstream 2.5 H:1V, downstream 2H:1V

Zoning - unknown

Impervious core - unknown

Cutoff - unknown

Grout curtain - unknown

h. Principal Spillway

Type - Concrete capped stone masonry

Length of weir - 60

Crest elevation - 424.7 feet NGVD

Low level outlet - none

U/S channel - Hope Lake

D/S channel - Beaver Brook

i. Emergency Spillway

Type - Concrete capping over stone masonry

Length of weir - 52.4

Crest elevation - 425.2

Gates - none

U/S channel - Hope Lake

D/S channel - Beaver Brook

j. Stoplog Spillway

Type - 4"x8" wood planks (4.5 ft long)

Length of weir - 4 feet

Crest elevation - 425.6 (with stoplogs) 421.6 (without stoplogs)

U/S channel - Hope Lake

D/S channel - Beaver Brook

SECTION 2
ENGINEERING DATA

2.1 Design

No original plans, hydraulic or hydrologic data for Hope Lake Dam were available.

2.2 Construction

No data concerning the original construction of Hope Lake Dam were revealed; however, owner indicated that it was built over 200 years ago.

2.3 Operation

No data pertaining to the operation of the dam were found.

2.4 Evaluation

a. Availability. A search of the New Jersey Department of Environmental Protection Files and contact with representatives of the owner of the dam revealed no pertinent information.

b. Adequacy. Evaluation was based primarily on visual observations and measurements which were adequate for this study.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. Dam. The area at the downstream toe of the dam is generally wet and soft and some clear seepage water is discharging. Trees are growing on the upstream slope, crest, on the downstream slope and in the area at the downstream toe of the dam. A large tree has been uprooted from the crest near the spillway at the right abutment and its root ball has been pulled out, leaving a large hole on the crest. Roots of trees were observed extending from the upstream slope near the water line toward the downstream edge of the crest.

The crest of the dam is partially covered with grass with a pedestrian path extending along the entire length. Considerable erosion has taken place on the upstream slope at and above the water line. The downstream slope has undergone considerable erosion and slumping adjacent to each of three spillways. In addition, erosion has occurred along portions of the toe that is due to water passing over the spillways and flowing adjacent to the toe in the discharge channels.

b. Appurtenant Structures.

(1) Ungated emergency spillway - left end. The concrete weir is badly eroded and irregular, and the downstream dry stone masonry wall has collapsed in several areas undermining the concrete apron. The entrance to the spillway is partially clogged with wood and grass vegetation. The left training wall is cracked and has settled approximately 1.5 inches.

(2) Gated spillway - middle of dam. The concrete walls and sill of the stoplog facility are badly eroded and spalled. Considerable undermining has occurred around the abutments of the spillway walls. An attempt to reduce erosion and seepage using gunite, sand bags, concrete, concrete blocks, and bags of cement beneath and adjacent to the spillway has not been successful. The wood stoplog gate is deteriorated and is leaking around the ends and through the joints. The wooden bridge is also badly weathered. The concrete block, cast-in-place concrete and stone masonry walls on top of the dam extending right and left from the gated spillway are cracked, irregular, and show considerable leakage on both sides. The downstream face is badly eroded and undermined on both sides of the spillway.

(3) Ungated principal spillway - right end. The crest of the spillway is cracked and eroded, and the downstream face is badly spalled causing undermining of the spillway. Seepage was noted near the left end of the spillway where the original crest had been repaired for about 5 feet from the left abutment of the spillway with stones and concrete.

c. Reservoir Area. The watershed above the lake is gently sloping and wooded. Some open fields exist along the west side of the reservoir. Slopes on the shore of the lake appear to be stable. Evidence of significant sedimentation was observed.

d. Downstream Channel. Considerable erosion has occurred on the right and left bank of each channel immediately downstream of the spillways for a distance of approximately 100 to 150 feet. Trees are growing on the banks of the channels and within the confines of the channels.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

No formal operating procedures were revealed.

4.2 Maintenance of Dam

No formal maintenance procedures for the dam were found.

4.3 Maintenance of Operating Facilities

No formal maintenance procedures for the operating facilities were discovered.

4.4 Warning System

No description of any warning system was found.

4.5 Evaluation of Operational Adequacy

Because of the lack of operation and maintenance procedures, the remedial measures described in Section 7.2 should be implemented as described.

SECTION 5
HYDROLOGIC/HYDRAULIC

5.1 Evaluation of Features

a. Design Data. Because no data were revealed an evaluation of the hydrologic/hydraulic data could not be performed.

b. Experience Data. No experience data were found.

c. Visual Observation. Erosion at left abutment of the principal spillway has been patched with stones (6"-8") and mortar. This area shows some leakage. The crest of the emergency spillway shows considerable spalling. The stone masonry beneath the emergency spillway slab apron has fallen along the downstream face leaving much of the slab without support. Water is leaking through the stone masonry (estimate about 5 to 10 gpm). The stoplog spillway training walls are structurally in poor condition. The stoplog notches are eroded with leakage around the ends and between the logs. The dam has no other low level outlet.

d. Hope Lake Overtopping Potential. The hydraulic/hydrologic evaluation for the dam is based on a selected Spillway Design Flood (SDF) equal to one-half the Probable Maximum Flood (PMF) in accordance with the range of test floods given in the evaluation guidelines, for dams classified as significant hazard and small in size. The PMF was determined by application of a 24-hour probable maximum storm of 23.1 inches to the SCS dimensionless unit hydrograph. Hydrologic computations are given in Appendix 3. The routed one-half PMF peak discharge for the subject drainage area is 8,385 cfs.

The minimum elevation of the dam allows 1.3 foot of depth above the principal spillway, 0.8 foot above the emergency spillway and 0.4 foot above the stoplog spillway (with stoplogs in place) before overtopping occurs. Under this head the total spillway capacity for the 3 spillways is 337 cfs, which is less than the selected SDF (approximately 4 percent).

At discharges above 6900 cfs, the backwater resulting from the narrowing and gradual slope of the channel downstream of the dam begins to cause slightly less flow over the dam than would occur without this backwater effect. Because this effect was found to be negligible for Hope Lake Dam, the discharge coefficient for the spillway weir was not changed. Calculations are shown in Appendix 3.

Flood routing calculations indicate that Hope Lake Dam will be overtopped for 13.2 hours to a maximum depth of 4.3 feet under one-half PMF conditions. It is estimated that the principal spillway can pass 2 percent (240 cfs) of the one-half PMF without overtopping the dam; thus, the spillway is considered inadequate.

3. Drawdown Capacity. There are no drawdown pipes for Hope Lake Dam.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. The soft, wet areas and seepage at the downstream toe of the dam is indicative of seepage through and under the dam, which, if not properly controlled, could lead to failure of the dam by piping or sloughing of the downstream slope. Trees growing on the crest and on the upstream and downstream slopes may cause seepage and erosion problems if a tree blows over and pulls out its roots, or if a tree dies or is cut and its roots rot. One large tree has already blown over, leaving a hole in the crest where its roots pulled out and this hole weakens the crest. Erosion at the abutments of the spillways and seepage below and adjacent to these structures could lead to breaching of the dam at these locations if not controlled. Erosion caused by overtopping of the upstream concrete walls on either side of the center spillway could lead to breaching.

Erosion of the upstream slope at the water line could eventually lead to breaching of the dam.

6.2 Design and Construction Data. No design or construction data pertinent to the structural stability of the dam are available.

6.3 Operating Records. No operating records pertinent to the structural stability of the dam were available.

6.4 Post-Construction Changes

No record of post-construction changes was available. However, evidence of numerous patchings are clearly visible.

6.5 Seismic Stability - This dam is in Seismic Zone 1. According to the Recommended Guidelines, dams located in Seismic Zone 1 "may be assumed to present no hazard from earthquake provided static stability conditions are satisfactory and conventional safety margins exist." None of the visual observations made during the inspection are indicative of unstable slopes. However, because no data are available concerning the engineering properties of the embankment and foundation materials for this dam, it is not possible to make an engineering evaluation of the stability of the slopes or the factor of safety under static conditions.

SECTION 7
ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Hope Lake is probably over 200 years old and is in very poor condition.

b. Adequacy of Information. The information available is such that the assessment of the dam must be based entirely on the results of the visual inspection.

c. Urgency. The recommendations made in 7.2.a and 7.2.b should be implemented by the owner as prescribed.

d. Necessity for Additional Data/Evaluation. The information available from the visual inspection is adequate to identify the potential problems which are listed in 7.2.a. These problems require the attention of a professional engineer who will have to make additional engineering studies to design or specify remedial measures to rectify the problems. If left unattended, the problems could lead to failure of the dam.

7.2 Recommendation/Remedial Measures

a. Recommendations

The owner should retain a professional engineer qualified in the design and construction of dams to accomplish the following in the time periods specified:

Immediately:

Investigate the cause of the seepage and wet, soft areas at the downstream toe of the dam.

Very soon:

(1) Design procedures for and inspect the removal of the trees and their roots from the entire embankment.

(2) Design procedures for and inspect the construction of erosion protection on the upstream slope of the dam.

(3) Design procedures for the repair or replacement of the gated and ungated spillways where considerable erosion and seepage are taking place.

(4) Design channels to reroute the flowing water away from the toe of the dam.

(5) Establish procedures and surpervise backfilling of the embankment sections on either side of the stoplog spillway.

In the near future:

(1) Further evaluate the hydrology and hydraulics of the watershed, reservoir, dam, and spillways, and design and implement necessary mitigating measures. Items b(2) and b(3) following should be considered in conjunction with this recommendation.

(2) Design and install adequate means to drain the reservoir in case of emergency.

b. Operating and Maintenance Procedures

The owner should do the following immediately:

(1) Clear debris and trees from the spillway discharge channels and maintain the channels free from debris.

(2) Check the condition of the dam periodically.

(3) Clear brush and uncontrolled vegetation from slopes of the dam and keep the slopes free from all debris.

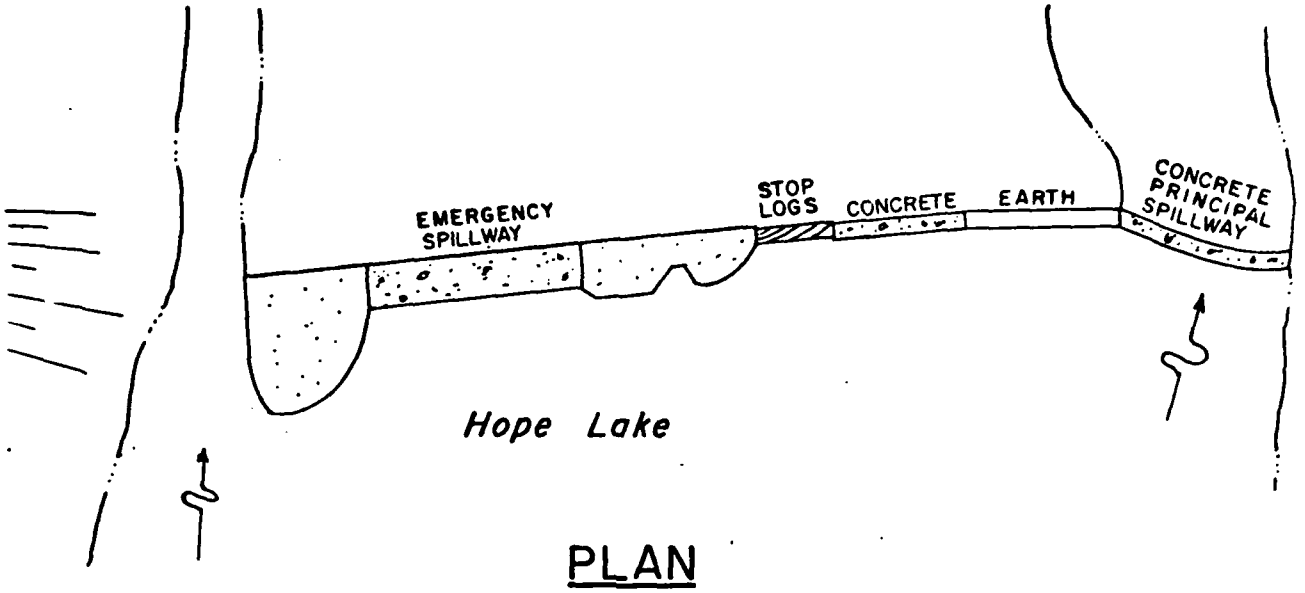
(4) Clear trees and brush for some distance downstream from the toe of the dam and from the banks of the discharge channels for some distance downstream from the spillways.

In the near future:

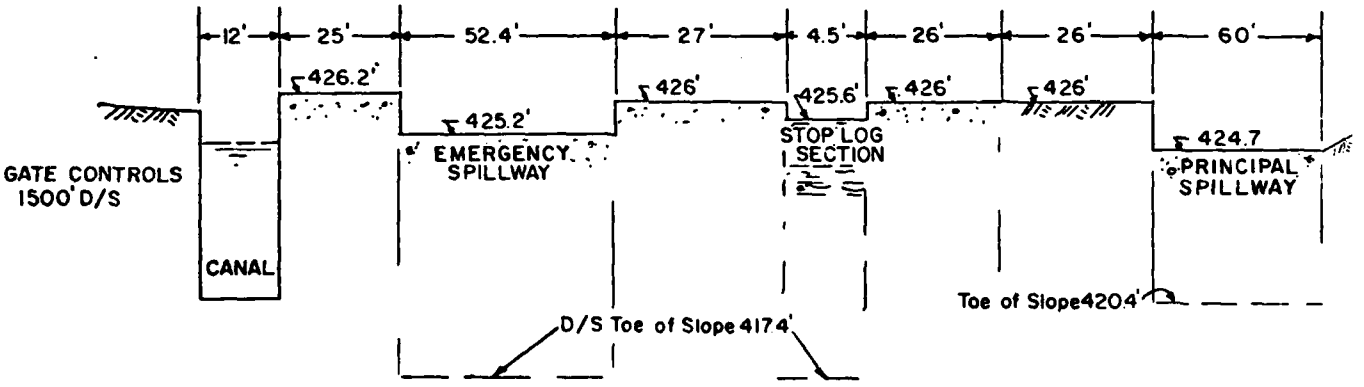
Develop written operation procedures and a periodic maintenance plan to ensure the safety of the dam.

In the future:

Establish a surveillance program for use during and immediately following periods of heavy rainfall and also a warning program to follow in case of emergency conditions.



PLAN



ELEVATION

Anderson-Nichols & Co, Inc. BOSTON MASSACHUSETTS	U.S ARMY ENGINEER DIST PHILADELPHIA CORPS OF ENGINEERS PHILADELPHIA, PA
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	
HOPE LAKE DAM	
BEAVER BROOK NEW JERSEY	
	SCALE NOT TO SCALE
	DATE MAY 1981 FIGURE 1

SCALE IN MILES

0 4 8

MAP BASED ON STATE OF NEW JERSEY OFFICIAL MAP & GUIDE.

Anderson-Nichols & Co., Inc. BOSTON MASSACHUSETTS	U.S. ARMY ENGINEER DIST. PHILADELPHIA CORPS OF ENGINEERS PHILADELPHIA, PA.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

HOPE LAKE DAM
LOCATION MAP

BEAVER BROOK NEW JERSEY

SCALE: 1" = 4 Miles Approx.

DATE: MAY 1981

FIGURE 2

APPENDIX 1

CHECK LIST

VISUAL INSPECTION

HOPE LAKE DAM

Check List
Visual Inspection
Phase 1

Name Dam Hope Lake (NJ00796) County Warren State New Jersey Coordinators NJDEP

Date(s) Inspection 2/16/81 4/22/81 Weather Fair, clear Clear, cold Temperature 36° 38°

Pool Elevation at Time of Inspection 424.9 NGVD Tailwater at Time of Inspection 418.2 NGVD

Inspection Personnel:

W. Guinan
J. Stone
S. Gilman
R. Murdock

Guinan/Gilman Recorder

Mrs. Charles Southwick, owner, was present with the inspection party.

UNGATED SPILLWAY
Right End of Dam

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Concrete weir is curved. Top surface is eroded and cracked. Right ends show evidence of movement. Downstream face is badly eroded and spalled undermining face and bottom of wall. Left end has been repaired with mortared cobbles-6-8 in ±. Seepage and leakage noted at both ends of spillway.	Major reconstruction required.
APPROACH CHANNEL	Under water, appears to be shallow, unobstructed.	
DISCHARGE CHANNEL	Debris, fallen trees, boulders in bottom channel, joins with discharge channel for gated spillway.	Clear trees and brush 25 ft on either side of discharge channel for a distance of 100 ft downstream from the dam or to the property line, whichever is less.
BRIDGE AND PIERS OVER SPILLWAY	None	

Stop Log Section and Adjacent Concrete Dam

GATED SPILLWAY
at Center of Dam

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Bottom of stop log section is eroded & deteriorated 1 in ±.	Major construction required of entire structure.
APPROACH CHANNEL	Upstream face of stop log section is badly deteriorated with concrete cap showing evidence of forward movement.	
DISCHARGE CHANNEL	Sidewalls are badly cracked and spalled. Some repairs have been made with mortared stone.	Clear trees and brush 25 ft on either side of discharge channel for a distance of 100 ft downstream from the dam.
BRIDGE AND PIERS	2 in wood planks are badly weathered with some deterioration.	See note above Major Construction
GATES AND OPERATION EQUIPMENT	Stop logs are deflected. All planks show evidence of deterioration. Leakage is observed around ends of stop log and thru joints. Stop log slots are badly eroded.	See note above Major Construction
CONCRETE DAM WALLS ADJACENT TO GATED SPILLWAY	Walls are cracked, irregular and show considerable leakage on both sides. D/S face is badly eroded and undermined on both sides.	See note above Major Construction

UNGATED SPILLWAY
Left End of Dam

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	The top of the concrete weir is badly eroded and uneven. D/S apron is in fair condition. Left training wall is cracked and has settled 1.5 in. Dry stone masonry wall on d/s face has collapsed in several areas.	Repair concrete weir. Repair dry stone masonry wall.
APPROACH CHANNEL	Under water, appears to be shallow, unobstructed.	
DISCHARGE CHANNEL	Debris, fallen trees, boulders in bottom channel, joins with discharge channel for gated spillway.	Clear trees and brush 25 ft on either side of discharge channel for a distance of 100 ft downstream from the dam or up to the property line, whichever is less.
BRIDGE AND PIERS OVER SPILLWAY	None.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None apparent.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Pronounced erosion on both upstream and downstream slopes. Trees present on both slopes.	Control trespassing on dam. Repair erosion on dam.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Horizontal alignment - fair. Vertical alignment - right undulation of crest.	
RIPRAP FAILURES	Slight amount of riprap evident below water surface. Only a few riprap pieces present on the slope.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
RAILINGS	None apparent.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Erosion at both abutments and at junction with spillway structure. See Notes in "Ungated Spillway" regarding concrete walls along embankment.	
ANY NOTICEABLE SEEPAGE	Seepage evident below and adjacent to spillway, emergency spillway and gated spillway.	Investigate seepage and design appropriate remedial measures.
STAFF GAGE AND RECORDER	None apparent.	
DRAINS	None apparent.	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None apparent.	
OBSERVATION WELLS	None apparent.	
WEIRS	None apparent.	
PIEZOMETERS	None apparent.	
OTHER	None apparent.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gradual slopes, wooded. Open fields.	
SEDIMENTATION	Appears to be significant sedimentation in the reservoir.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Debris, boulders in channel. Banks heavily overgrown with trees and vines.	
SLOPES	Trees and brush covered, gentle slopes on the right bank; tree- and brush-covered steep slopes with a flat flood plain on the left bank.	
APPROXIMATE NO. OF HOMES AND POPULATION	One house about 0.1 mile downstream on left bank with 2 residents. The first floor is about 14 feet above the channel invert. Three empty buildings (corn canning plant) on the right bank are within 100 yards of the dam with a first floor elevation from 8 to 10 ft above channel bottom.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	None found
REGIONAL VICINITY MAP	Prepared for this report
CONSTRUCTION HISTORY	None found
TYPICAL SECTIONS OF DAM	None
HYDROLOGIC/HYDRAULIC DATA	None
OUTLETS - PLAN	None found
- DETAILS	None found
- CONSTRAINTS	None found
- DISCHARGE RATINGS	None found
RAINFALL/RESERVOIR RECORDS	None found

ITEM	REMARKS
DESIGN REPORTS	None found
GEOLOGY REPORTS	None found
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None found
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None found
POST-CONSTRUCTION SURVEYS OF DAM	None found
BORROW SOURCES	Unknown

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	None
HIGH POOL RECORDS	None
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None
MAINTENANCE OPERATION RECORDS	None

ITEMS		REMARKS
SPILLWAY PLAN		Prepared for this report from field inspection
	SECTIONS	None
	DETAILS	None
OPERATING EQUIPMENT PLANS & DETAILS		None

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 7.7 square miles, gentle slope, woods.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 424.7' NGVD (64 acre-feet).

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY) Not applicable

ELEVATION MAXIMUM HIGH POINT ON DAM: 426.2' NGVD

ELEVATION TOP DAM: 426.0'NGVD

PRINCIPAL SPILLWAY CREST: Uncontrolled concrete capped stone masonry

a. Elevation 424.7' NGVD
b. Type Concrete
c. Width 2 feet
d. Length 60 feet
e. Location Spillover Right end of dam
f. Number and Type of Gates None

EMERGENCY SPILLWAY CREST: Free overflow concrete spillway

a. Elevation 425.2' NGVD
b. Type Concrete
c. Width 12.5 feet w/aprons up and downstream
d. Length 52.4 feet
e. Location Spillover Left of center of dam
f. Number and Type of Gates None

STOPLOG SECTION: 4" x 8 " wood planks .

a. Elevation 426.5" NGVD

b. Type Wood planks

c. Width 4 inches

d. Length 4.5 feet

e. Location Spillover Center of dam

f. Number and Type of Gates Four 4" x 8" stoplogs

OUTLET WORKS: None

HYDROMETEOROLOGICAL GAGES: None

MAXIMUM NON-DAMAGING DISCHARGE: 337 cfs (Total spillway capacity)

APPENDIX 2

PHOTOGRAPHS

HOPE LAKE DAM

21 April 1981

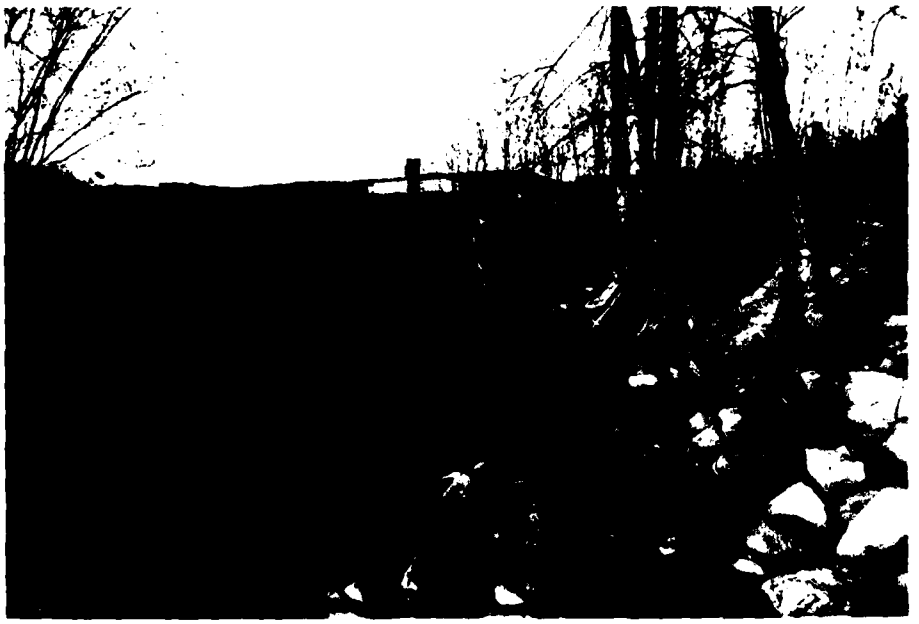
Spillway crest looking toward left (east) side of dam

21 April 1981

Looking eastward across emergency spillway crest and apron

21 April 1981

View of downstream face of emergency spillway



21 April 1981

Looking u/s at stoplog spillway

21 April 1981

View of undermining of concrete cap on stoplog spillway training wall.

21 April 1981

Outside and d/s appearance of right training wall of stoplog spillway

18 February 1981

Looking u/s across Hope Lake Reservoir

21 April 1981

Spillway channel looking downstream

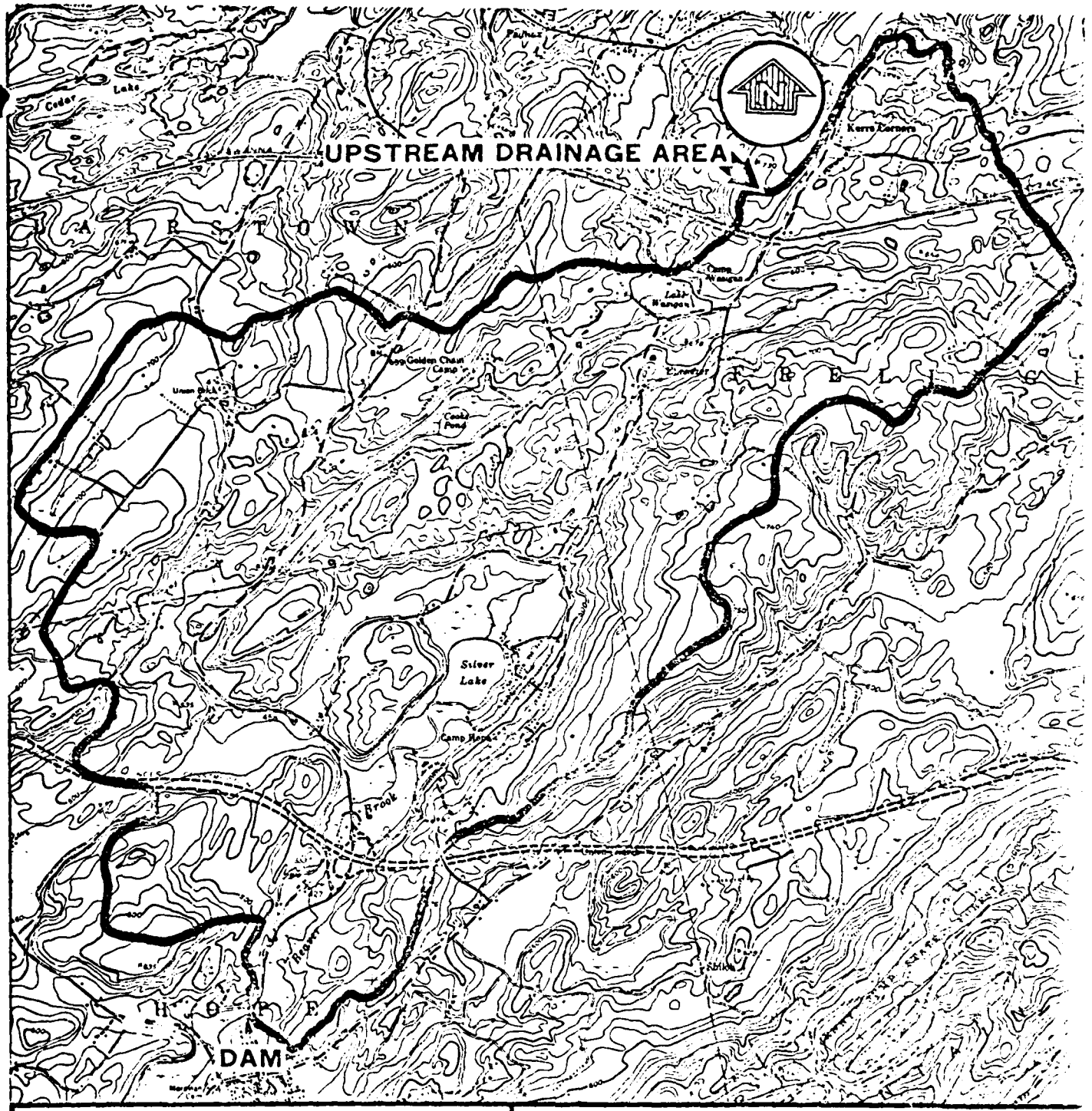
21 April 1981

Mill Race looking d/s near left (east) end of dam

APPENDIX 3

HYDROLOGIC COMPUTATIONS

HOPE LAKE DAM



NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

HOPE LAKE DAM
HOPE TOWNSHIP, NEW JERSEY

REGIONAL VICINITY MAP

MAY 1981

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

Anderson-Nichols & Company, Inc. BOSTON, MA.

SCALE IN MILES

0 1/2 1

MAP BASED ON U.S.G.S. 7.5 MINUTE QUADRANGLE SHEET. BLAIRSTOWN, N.J. 1954, REVISED 1971.

Anderson-Nichols & Company, Inc. Subject [illegible]

JOB NO.

Sheet No. [illegible] of [illegible]
Date 5/15/81
Computed CLP
Checked [illegible]

TIME OF CONCENTRATION

(1) Texas Highway Method

Overland
woodlands
reach = 5000'

$$\text{slope} = \frac{734 - 600}{5000} = 0.027$$

ave vel = 1 fps $\quad \frac{5000 \text{ ft}}{1 \text{ ft/sec}} = 5000 \text{ sec}$

= 83 min = 1.4 hrs.

Channel

reach = 25,000'

$$\text{slope} = \frac{600 - 435}{25000} = .007$$

ave vel = 2 fps $\quad \frac{25000'}{2 \text{ ft/sec}} = 12500 \text{ sec}$

= 208 min = 3.5 hrs

Total T_c = 1.4 + 3.5 = 4.9 hrs

(2) Soil & Water Conservation

$$L = \frac{l^{0.8} (S+1)^{1.67}}{9000\, y^{0.5}}$$

$$S = \frac{1000}{CN} - 10$$

CN = 70 for [illegible]

l = 5000 + 25000 = 30,000'

$S = \frac{1000}{70} - 10 = 4.$

$$y = \frac{.027 + .007}{2} = 0.017 = 1.7\%$$

$$L = \frac{(30{,}000)^{0.8}\ (4.3+1)^{1.67}}{9000\ (17)^{.5}} = 5.2 \text{ hrs.}$$

$$T_c = \frac{L}{.6} = \frac{5.2}{.6} = \underline{\underline{8.7 \text{ hrs}}}$$

③ SCS TR #55 Method

overland

$l = 5{,}000$ head = 134'

slope = 0.027 Woodland

from plot of % slope vs. velocity, $V = .4$ fps

$$\frac{5000 \text{ ft}}{.4 \text{ ft/sec}} = 12500 \text{ sec} = 03.5 \text{ hrs}$$

channel

$l = 25{,}000'$ slope = 0.007 $n = .03$

$$V = \frac{1.49}{n} R^{2/3} S^{1/2}$$

(assume 1' x 10' rectangular channel to calculate R)

$$R = \frac{A}{wp} = \frac{10}{2(1)+10} = 0.83 \text{ ft}^2$$

$$V = \frac{1.49}{.03} (0.83)^{2/3} (.007)^{\frac{1}{2}} = 3.7 \text{ ft/sec}$$

$$\frac{25000 \text{ ft}}{3.7 \text{ ft/sec}} = 6793 \text{ sec} = 1.9 \text{ hrs}$$

Total = 1.9 + 3.5 = $\underline{\underline{5.4 \text{ hrs}}}$

(4) Kerby Method

$$T_c = 0.83 \left(\frac{N \ell}{\sqrt{s}} \right)^{0.467} \quad \text{OVERLAND}$$

$\ell = 5000'$ $s = .027$ $N = 0.60$

$$T_c = 0.83 \left[\frac{(0.6)(5000)}{\sqrt{.027}} \right]^{0.467} = 1.4 \text{ hrs}$$

for channel use

Manning's, as Method 3

$V = 3.6$ fps $\frac{25000 \text{ ft}}{3.6 \text{ ft/sec}} = 6944 \text{ sec} = 1.9$ hrs.

$T_c = 1.4 + 1.9 = 3.3$ hrs.

$$T_c \text{ ave} = \frac{4.9 + 8.7 + 5.4 + 3.3}{4} = 5.6 \text{ hrs}$$

$$T_{lag} = 0.6 \times 5.6 = 3.3 \text{ hrs}$$

Anderson-Nichols & Company, Inc.

Subject: Hope Lake

Sheet No. 4 of 11
Date: 4/17/81
Computed: [illegible]
Checked: [illegible]

JOB NO.

SQUARES 1/4 IN. SCALE

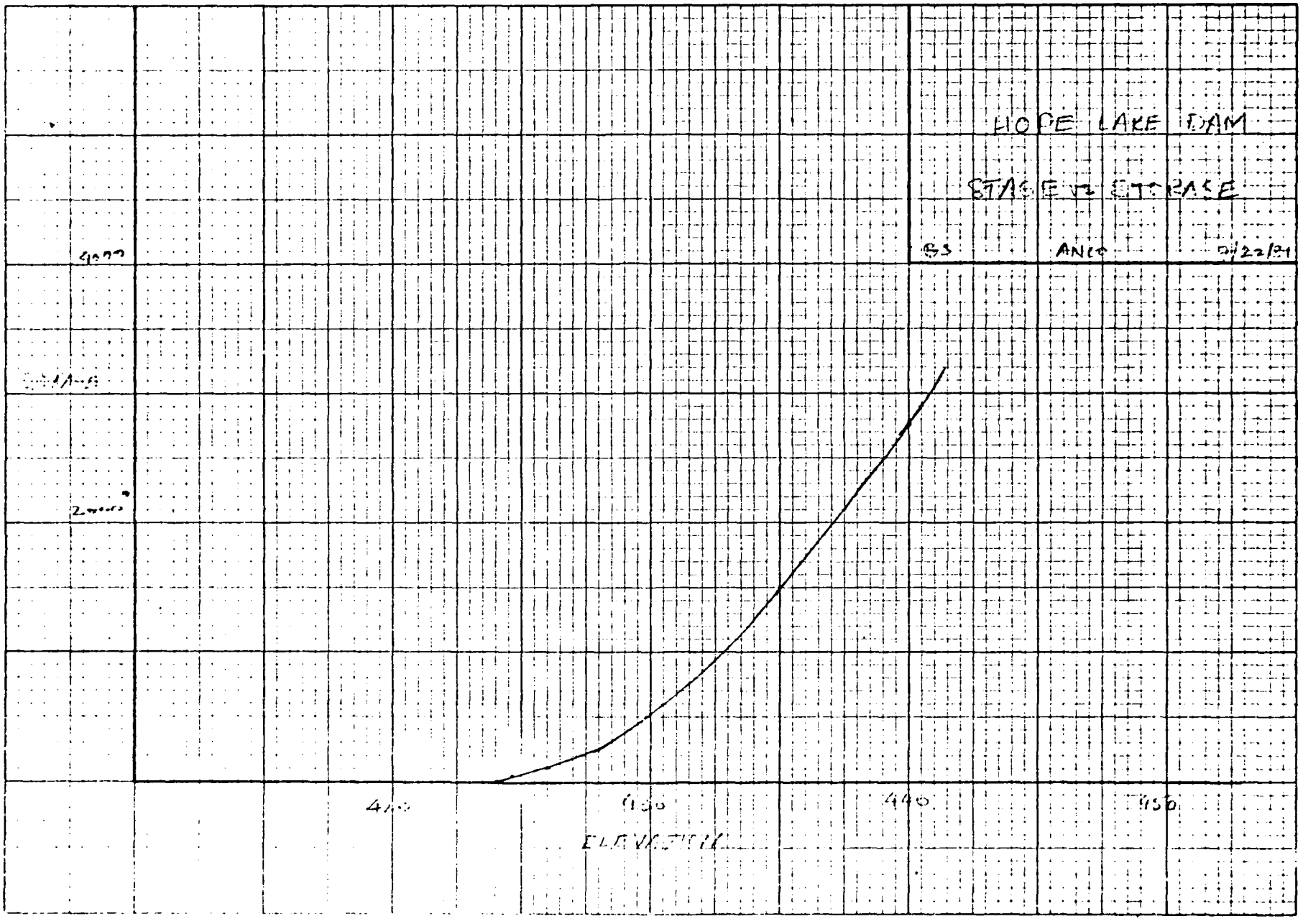
STAGE - STORAGE DETERMINATIONS

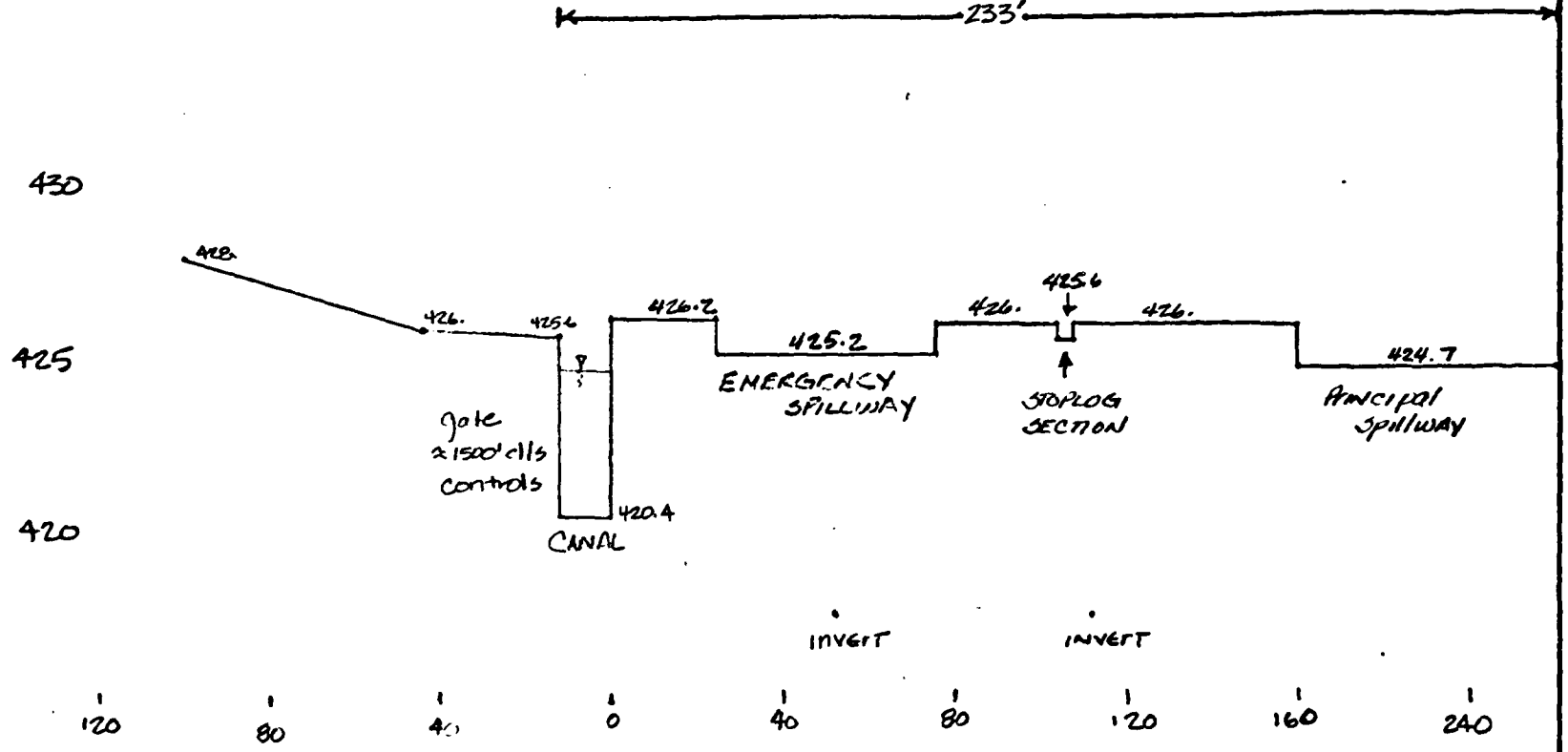
ASSUME DEPTH OF LAKE to be 5 Feet

Elevation	Surface Area Acres	Avg S.A. Acres	Incremental Storage Ac-Ft	Cummulative Storage Ac-Ft
		12.8	64	
424.7	12.8			64
		176	2692.8	
440	345.6			2756.8
		480	9600	
460	614.4			12356.8

Input for HEC-I (from curve)

	Stage	Storage
	424.0	0
spillway	[illegible]1	64
elevation,	425.2	70
[illegible]	425.6	85
[illegible]	426.0	110
	426.2	115
	428.	200
	430	520
	[illegible]	850
	435.0	1500
	440.0	2757





ANDERSON-NICHOLS

VERNON BOSTON CONCORD

HOPE LAKE DAM

SPILLWAY & DAM XSECTION KGS

DATE	SCALE:	JOB NO.	SHEET NO.
7-27-81		3670-06	6 OF 11

Anderson-Nichols & Company, Inc.

Subject Hope Lake

Sheet No. 7 of 11
Date 5/11/81
Computed CLP
Checked KEP

JOB NO.

DEVELOPMENT OF RATING CURVE

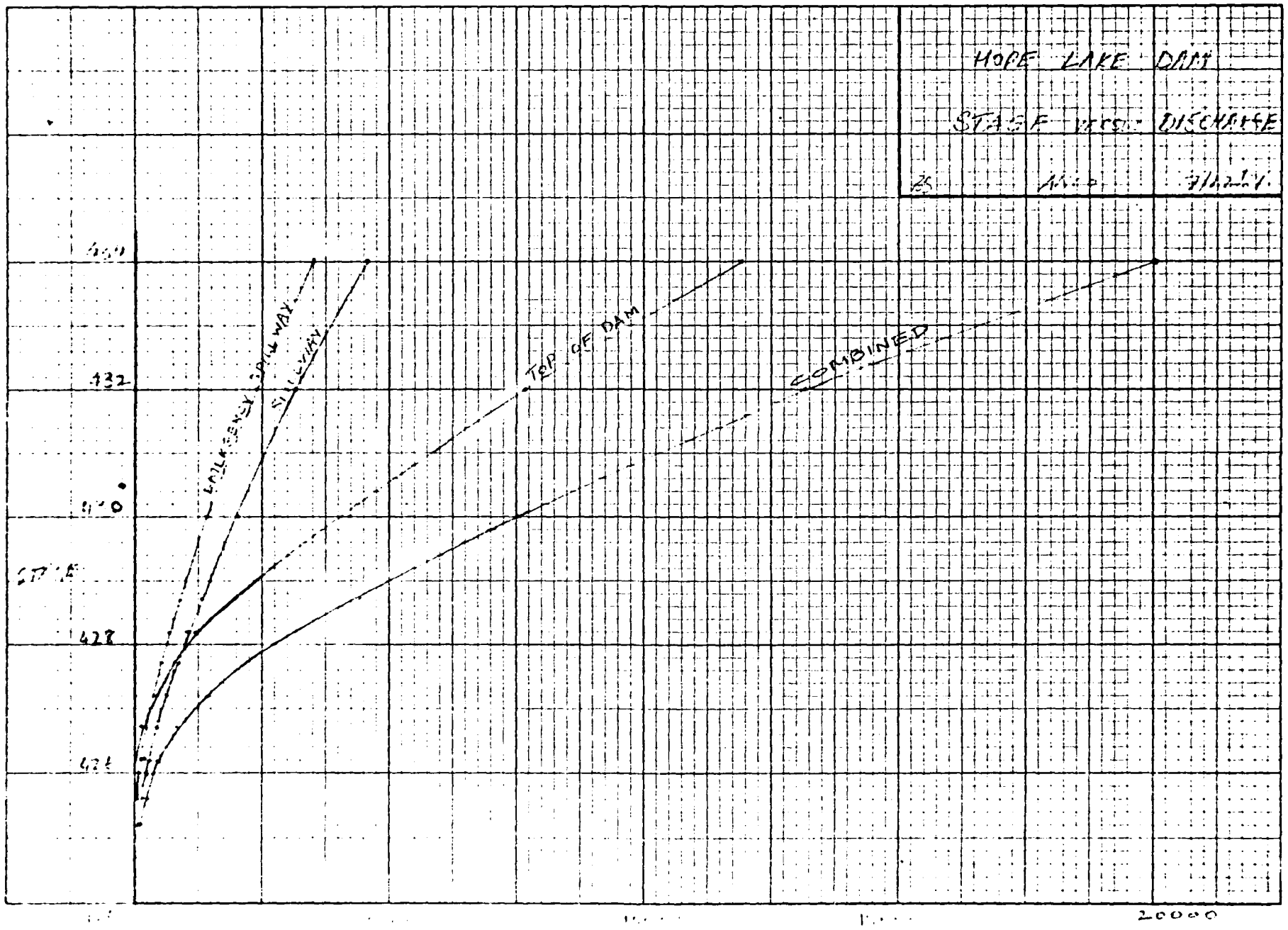
$Q = CLH^{3/2}$

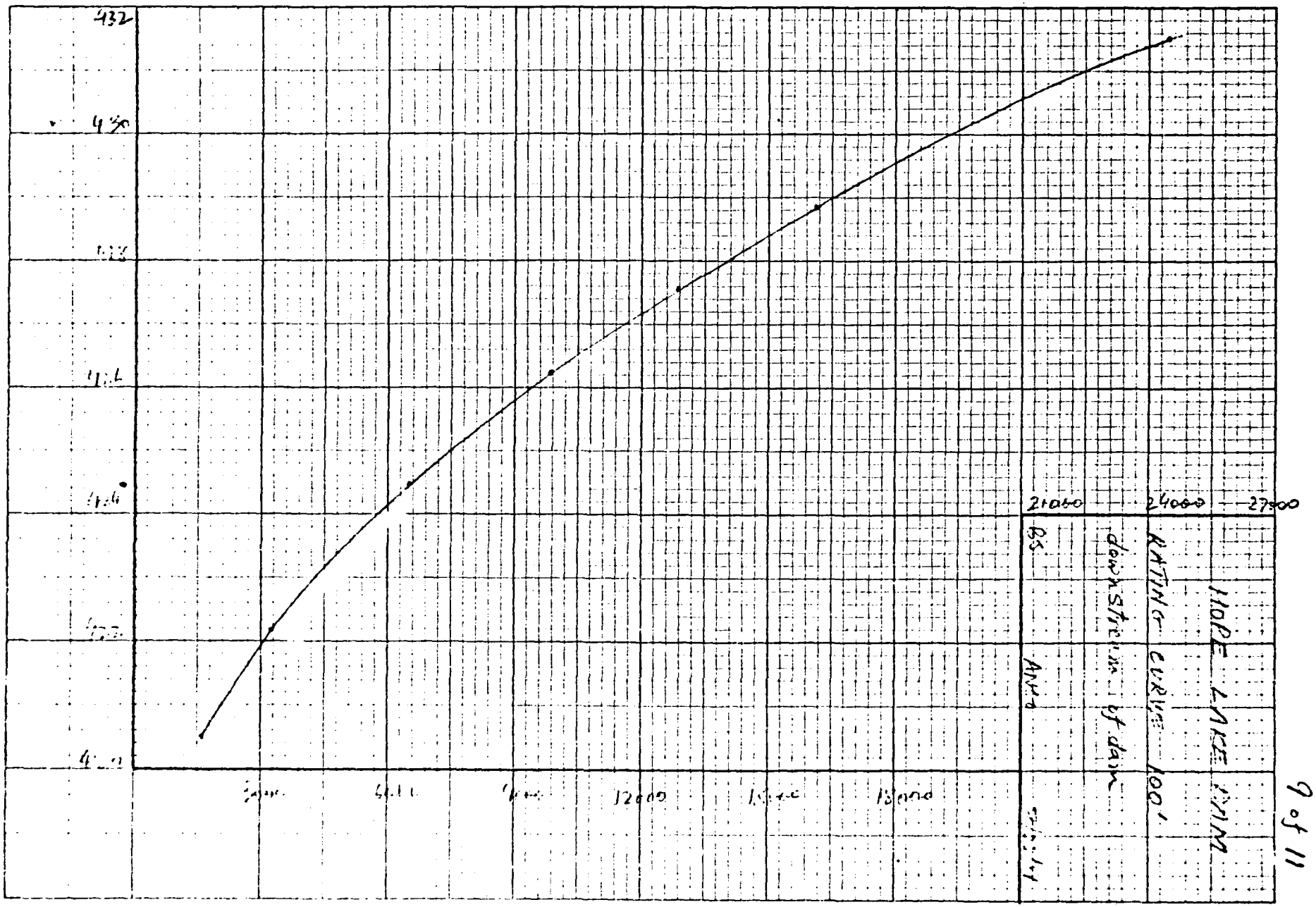
(1) Spillway curve
C = 2.7 L = 60 width = 2.0

(2) Top of dam curve
C = 2.6 L = 153+ width = 12.5

(3) Emergency spillway
C = 2.6 L = 52 width = 6.5

	Elevation	Principal Spillway		Emergency Spillway		Top of Dam			Combined
		head	Q	head	Q	head	length	Q	Q
Spillway	424.7	0							
emergency	425.2	0.5	51.2	0					57
spillway	425.6	1.0	162	0.5	48				210
TOP DAM	426.0	1.3	240	0.8	97				337
	426.2	1.5	298	1.0	135		153		433
	426.7	2.0	459	1.5	248	0.5	153	140	246
	427.2	2.5	640	2.0	382	1.0	170	442	1464
	427.7	3.0	842	2.5	534	1.5	170	312	2193
	428.2	3.5	1061	3.0	701	2.0	190	[illegible]	[illegible]
	428.7	4.0	1296	3.5	884	2.5	190	1159	4133
	430.0	5.3	1777	4.8	1420	3.8	210	4045	7442
	432.0	7.3	2195	6.8	2514	5.8	210	7627	14216
	434.0	9.3	4595	8.8	3824	7.8	210	11314	20013





Anderson-Nichols & Company, Inc. Subject HOPE LAKE Sheet No. 14 of 1
Date 5-23-01
Computed LDS
Checked
JOB NO.

Weir Submergence Calculations

SQUARES 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
3/4 IN. SCALE

Data for Rating Curve @ 100' downstream from HEC-1

1	FLOW	1646.	3223.	6477.	9782.	12868.	16137.	24513.	33009.
	TIME	19.67	19.83	19.75	19.75	19.83	19.83	19.75	19.67
** PEAK STAGES IN FEET **									
1	STAGE	420.52	422.16	424.45	426.22	427.57	428.82	431.46	433.66
	TIME	19.67	19.83	19.75	19.75	19.83	19.75	19.67	19.67

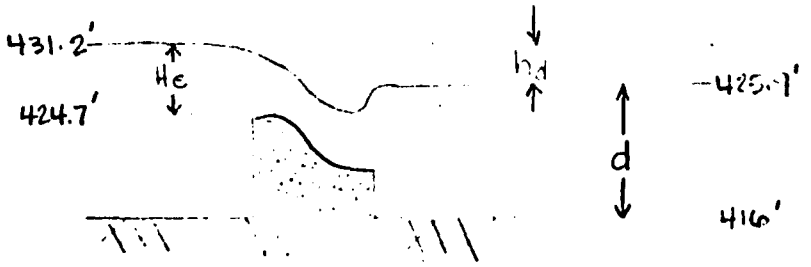
FROM HEC 1 CALCULATION -

1/2 PMF Q = 8114 CFS

1/2 PMF ELEV @ d/s Xsect. = 425.9'

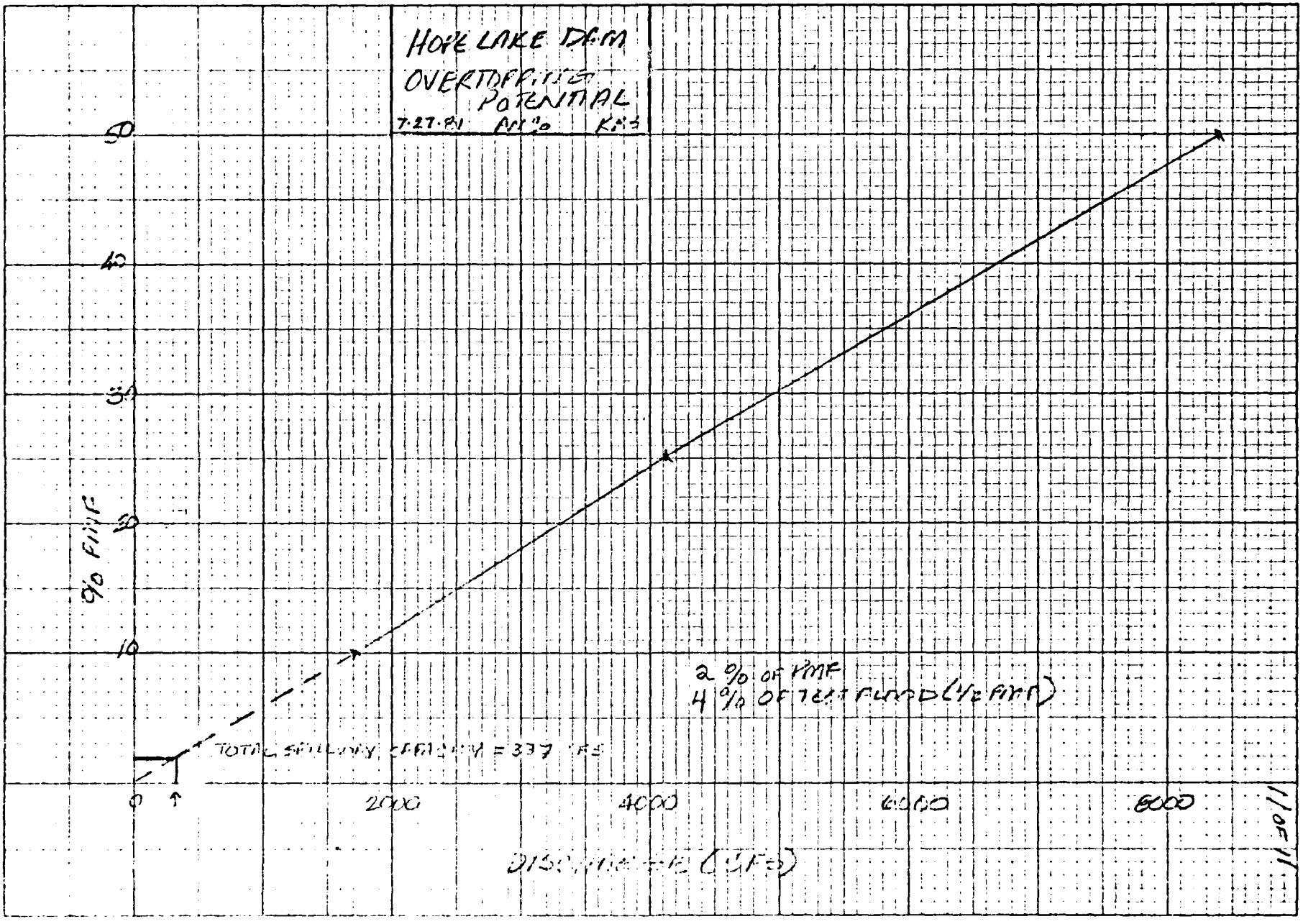
1/2 PMF ELEV @ dam = 431.2'

Calculations of decrease in discharge coefficient for sharp crested spillway (using Henderson's Chow's Open Channel Hydraulics, 1951)



Q	RIV @ XSECT	ELEVATION	% DECREASE	hd	He	d	hd/He	h1/
8114	425.9	431.2	1.2	5.3	6.5	9.7	0.8	

0.23% reduction in 'C' value for weir (using Chow) - negligible



APPENDIX 4

HEC-1 OUTPUT

HOPE LAKE DAM

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
   1      ID    HOPE LAKE  DAM              OVERTOPPING  ANALYSIS  ##KBSOMERVILLE A-N&CO INC##
   2      ID    NEW JERSEY DAM NO.796  WARREN COUNTY    TOWNSHIP OF HOPE
   3      IO    0.1,0.25.0.5 MULTIPLES OF PMF FROM 24-HOUR PMP
   4      IT       5                0        300
   5      IO       2                2
   6      JR    FLOW      0.1     0.25      0.5

   7      KK       A1 HOPE LAKE DAM
   8      KM       SCS UNIT GRAPH   COMPUTATION
   9      BA      7.7               0
  10      LS     23.1      23.1             1
  11      PH    23.50                      ND      111      123      132
  12      LU         1        .1           5
  13      UD      3.3

  14      KK       A2  ROUTE INFLOW HYDROGRAPH THROUGH HOPE LAKE
  15      RS        1    STOR          64
  16      SV        0      64          70      100      150      180      210      350      520      850
  17      SE    417.4   424.7   425.2   426.   426.7   427.2   427.7   428.7   430      432
  18      SQ       0.      0.      57.   337.    846.   1464.   2188.   4133.   7442.  13216.
  19      SE    417.4   424.7   425.2   426.   426.7   427.2   427.7   428.7   430.     432.
  20      SS    424.7      60      2.7     1.5
  21      ST    426.0     173      0.0     1.5
  22      ZZ
```

```
FLOOD HYDROGRAPH PACKAGE (HEC-1)
         FEBRUARY 1981

RUN DATE07/23/81      TIME17.25.10
```

```
U.S. ARMY CORPS OF ENGINEERS
THE HYDROLOGIC ENGINEERING CENTER
609 SECOND STREET
DAVIS, CALIFORNIA 95616
(916) 440-3285 OR (FTS) 448-3285
```

```
HOPE LAKE  DAM            OVERTOPPING  ANALYSIS  ##KBSOMERVILLE A-N&CO INC##
NEW JERSEY DAM NO.796  WARREN COUNTY    TOWNSHIP OF HOPE
0.1.0.25.0.5 MULTIPLES OF PMF FROM 24-HOUR PMP

5 IO      OUTPUT CONTROL VARIABLES
               IPRNT          2  PRINT CONTROL
               IPLOT          2  PLOT CONTROL
               PSCAL          0.  HYDROGRAPH PLOT SCALE
               MSG          YES  PRINT DIAGNOSTIC MESSAGES

  IT      HYDROGRAPH TIME DATA
               MIN            5  MINUTES IN COMPUTATION INTERVAL
             IDATE      1    0  STARTING DATE
             ITIME         0000  STARTING TIME
                NQ          300  NUMBER OF HYDROGRAPH ORDINATES
             NDDATE     2    0  ENDING DATE
             NDTIME        0055  ENDING TIME

          COMPUTATION INTERVAL     0.08 HOURS
              TOTAL TIME BASE     24.92 HOURS

    ENGLISH UNITS
        DRAINAGE AREA          SQUARE MILES
        PRECIPITATION DEPTH    INCHES
        LENGTH, ELEVATION      FEET
        FLOW                   CUBIC FEET PER SECOND
        STORAGE VOLUME         ACRE-FEET
        SURFACE AREA           ACRES
        TEMPERATURE            DEGREES FAHRENHEIT

  JP      MULTI-PLAN OPTION
             NPLAN          1  NUMBER OF PLANS

  JR      MULTI-RATIO OPTION
             RATIOS OF RUNOFF
          0.10      0.25      0.50
```

```
7 KK      A1        HOPE LAKE DAM

                SCS UNIT GRAPH   COMPUTATION

      SUBBASIN RUNOFF DATA

9 BA      SUBBASIN CHARACTERISTICS
             TAREA        7.70  SUBBASIN AREA

C BF      BASE FLOW CHARACTERISTICS
             STRTQ       23.10  INITIAL FLOW
             QRCSN       23.10  BEGIN BASE FLOW RECESSION
             RTIOR     1.00000  RECESSION CONSTANT
```

PRECIPITATION DATA

PM PROBABLE MAXIMUM STORM

PMS	23.60	INDEX PRECIPITATION
TRSPC	0.80	TRANSPOSITION COEFFICIENT
TASDA	7.70	TRANSPOSITION AREA
SWD	NO	USE SWD DISTRIBUTION

PERCENT OF INDEX PRECIPITATION OCCURRING IN GIVEN TIME

6-HR	12-HR	24-HR	HR	72-HR	96-HR
111.0	123.0	132.0	.0	0.0	0.0

LU UNIFORM LOSS RATE

STRTL	1.00	INITIAL LOSS
CNSTL	0.10	UNIFORM LOSS RATE
RTIMP	5.00	PERCENT IMPERVIOUS AREA

UD SCS DIMENSIONLESS UNITGRAPH

TLAG	3.30	LAG

***

UNIT HYDROGRAPH TRUNCATED FROM 200 TO 150 INTERVALS

UNIT HYDROGRAPH
150 END-OF-PERIOD ORDINATES
VOLUME = 1.00

8.	17.	25.	34.	53.	73.	92.	112.	137.	162.
187.	212.	245.	279.	312.	346.	390.	435.	480.	524.
577.	630.	683.	736.	781.	826.	871.	915.	947.	978.
1009.	1039.	1057.	1074.	1091.	1108.	1112.	1114.	1117.	1120.
1116.	1115.	1112.	1109.	1094.	1077.	1061.	1044.	1025.	1005.
966.	966.	944.	922.	899.	877.	850.	822.	794.	766.
733.	700.	666.	633.	604.	576.	548.	520.	499.	480.
460.	440.	423.	406.	390.	373.	358.	344.	330.	316.
306.	295.	285.	275.	265.	255.	244.	234.	225.	217.
209.	200.	192.	183.	175.	167.	160.	155.	149.	144.
138.	132.	127.	121.	117.	113.	108.	104.	100.	96.
92.	87.	84.	81.	76.	75.	72.	69.	66.	63.
60.	58.	56.	54.	52.	50.	48.	45.	44.	42.
41.	39.	38.	36.	35.	33.	32.	31.	30.	28.
27.	26.	25.	24.	23.	22.	21.	20.	20.	19.

HYDROGRAPH AT STATION A1

DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
1		0000	1	0.0	0.0	0.0	23.
1		0005	2	0.01	0.01	0.00	23.
1		0010	3	0.01	0.01	0.00	23.
1		0015	4	0.01	0.01	0.00	23.
1		0020	5	0.01	0.01	0.00	23.
1		0025	6	0.01	0.01	0.00	23.
1		0030	7	0.01	0.01	0.00	23.
1		0035	8	0.01	0.01	0.00	23.
1		0040	9	0.01	0.01	0.00	23.
1		0045	10	0.01	0.01	0.00	23.
1		0050	11	0.01	0.01	0.00	23.
1		0055	12	0.01	0.01	0.00	24.
1		0100	13	0.01	0.01	0.00	24.
1		0105	14	0.01	0.01	0.00	24.
1		0110	15	0.01	0.01	0.00	24.
1		0115	16	0.01	0.01	0.00	24.
1		0120	17	0.01	0.01	0.00	24.
1		0125	18	0.01	0.01	0.00	24.
1		0130	19	0.01	0.01	0.00	25.
1		0135	20	0.01	0.01	0.00	25.
1		0140	21	0.01	0.01	0.00	25.
1		0145	22	0.01	0.01	0.00	25.
1		0150	23	0.01	0.01	0.00	26.
1		0155	24	0.01	0.01	0.00	26.
1		0200	25	0.01	0.01	0.00	26.
1		0205	26	0.01	0.01	0.00	27.
1		0210	27	0.01	0.01	0.00	27.
1		0215	28	0.01	0.01	0.00	27.
1		0220	29	0.01	0.01	0.00	28.
1		0225	30	0.01	0.01	0.00	28.
1		0230	31	0.01	0.01	0.00	29.
1		0235	32	0.01	0.01	0.00	29.
1		0240	33	0.01	0.01	0.00	30.
1		0245	34	0.01	0.01	0.00	30.
1		0250	35	0.01	0.01	0.00	31.
1		0255	36	0.01	0.01	0.00	31.
1		0300	37	0.01	0.01	0.00	32.
1		0305	38	0.01	0.01	0.00	32.
1		0310	39	0.01	0.01	0.00	33.
1		0315	40	0.01	0.01	0.00	33.
1		0320	41	0.01	0.01	0.00	34.
1		0325	42	0.01	0.01	0.00	34.
1		0330	43	0.01	0.01	0.00	35.
1		0335	44	0.01	0.01	0.00	35.
1		0340	45	0.01	0.01	0.00	36.
1		0345	46	0.01	0.01	0.00	36.
1		0350	47	0.01	0.01	0.00	37.
1		0355	48	0.01	0.01	0.00	37.
1		0400	49	0.01	0.01	0.00	38.
1		0405	50	0.01	0.01	0.00	38.
1		0410	51	0.01	0.01	0.00	39.
1		0415	52	0.01	0.01	0.00	39.
1		0420	53	0.01	0.01	0.00	40.
1		0425	54	0.01	0.01	0.00	40.
1		0430	55	0.01	0.01	0.00	41.
1		0435	56	0.01	0.01	0.00	41.
1		0440	57	0.01	0.01	0.00	42.
1		0445	58	0.01	0.01	0.00	42.
1		0450	59	0.01	0.01	0.00	42.
1		0455	60	0.01	0.01	0.00	43.
1		0500	61	0.01	0.01	0.00	43.
1		0505	62	0.01	0.01	0.00	43.
1		0510	63	0.01	0.01	0.00	44.

DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
1		1230	151	0.17	0.01	0.17	1171.
1		1235	152	0.17	0.01	0.17	1196.
1		1240	153	0.17	0.01	0.17	1223.
1		1245	154	0.17	0.01	0.17	1253.
1		1250	155	0.17	0.01	0.17	1286.
1		1255	156	0.17	0.01	0.17	1322.
1		1300	157	0.17	0.01	0.17	1362.
1		1305	158	0.21	0.01	0.20	1406.
1		1310	159	0.21	0.01	0.20	1455.
1		1315	160	0.21	0.01	0.20	1508.
1		1320	161	0.21	0.01	0.20	1567.
1		1325	162	0.21	0.01	0.20	1632.
1		1330	163	0.21	0.01	0.20	1704.
1		1335	164	0.21	0.01	0.20	1782.
1		1340	165	0.21	0.01	0.20	1868.
1		1345	166	0.21	0.01	0.20	1961.
1		1350	167	0.21	0.01	0.20	2063.
1		1355	168	0.21	0.01	0.20	2173.
1		1400	169	0.21	0.01	0.20	2291.
1		1405	170	0.26	0.01	0.25	2417.
1		1410	171	0.26	0.01	0.25	2551.
1		1415	172	0.26	0.01	0.25	2692.
1		1420	173	0.26	0.01	0.25	2841.
1		1425	174	0.26	0.01	0.25	2997.
1		1430	175	0.26	0.01	0.25	3160.
1		1435	176	0.26	0.01	0.25	3330.
1		1440	177	0.26	0.01	0.25	3506.
1		1445	178	0.26	0.01	0.25	3688.
1		1450	179	0.26	0.01	0.25	3876.
1		1455	180	0.26	0.01	0.25	4068.
1		1500	181	0.26	0.01	0.25	4266.
1		1505	182	0.24	0.01	0.23	4468.
1		1510	183	0.32	0.01	0.31	4674.
1		1515	184	0.40	0.01	0.39	4884.
1		1520	185	0.48	0.01	0.47	5100.
1		1525	186	0.71	0.01	0.71	5322.
1		1530	187	1.35	0.01	1.34	5557.
1		1535	188	1.98	0.01	1.97	5811.
1		1540	189	0.87	0.01	0.86	6075.
1		1545	190	0.63	0.01	0.63	6349.
1		1550	191	0.40	0.01	0.39	6636.
1		1555	192	0.32	0.01	0.31	6945.
1		1600	193	0.24	0.01	0.23	7263.
1		1605	194	0.24	0.01	0.24	7587.
1		1610	195	0.24	0.01	0.24	7918.
1		1615	196	0.24	0.01	0.24	8260.
1		1620	197	0.24	0.01	0.24	8606.
1		1625	198	0.24	0.01	0.24	8957.
1		1630	199	0.24	0.01	0.24	9315.
1		1635	200	0.24	0.01	0.24	9687.
1		1640	201	0.24	0.01	0.24	10065.
1		1645	202	0.24	0.01	0.24	10447.
1		1650	203	0.24	0.01	0.24	10838.
1		1655	204	0.24	0.01	0.24	11246.
1		1700	205	0.24	0.01	0.24	11658.
1		1705	206	0.19	0.01	0.18	12072.
1		1710	207	0.19	0.01	0.18	12490.
1		1715	208	0.19	0.01	0.18	12915.
1		1720	209	0.19	0.01	0.18	13338.
1		1725	210	0.19	0.01	0.18	13753.
1		1730	211	0.19	0.01	0.18	14154.
1		1735	212	0.19	0.01	0.18	14532.
1		1740	213	0.19	0.01	0.18	14885.

1	0515	64	0.01	0.01	0.00	44.	*	1	1745	214	0.19	0.01	0.18	15241.			
1	0520	65	0.01	0.01	0.00	44.	*	1	1750	215	0.19	0.01	0.18	15[illegible].			
1	0525	66	0.01	0.01	0.00	45.	*	1	1755	216	0.19	0.01	0.18	15[illegible].			
1	0530	67	0.01	0.01	0.00	45.	*	1	1800	217	0.19	0.01	0.18	16127.			
1	0535	68	0.01	0.01	0.00	45.	*	1	1805	218	0.01	0.01	0.01	16378.			
1	0540	69	0.01	0.01	0.00	45.	*	1	1810	219	0.01	0.01	0.01	16604.			
1	0545	70	0.01	0.01	0.00	46.	*	1	1815	220	0.01	0.01	0.01	16795.			
1	0550	71	0.01	0.01	0.00	46.	*	1	1820	221	0.01	0.01	0.01	16965.			
1	0555	72	0.01	0.01	0.00	46.	*	1	1825	222	0.01	0.01	0.01	17113.			
1	0600	73	0.01	0.01	0.00	46.	*	1	1830	223	0.01	0.01	0.01	17234.			
1	0605	74	0.03	0.03	0.00	47.	*	1	1835	224	0.01	0.01	0.01	17319.			
1	0610	75	0.03	0.03	0.00	47.	*	1	1840	225	0.01	0.01	0.01	17363.			
1	0615	76	0.03	0.03	0.00	47.	*	1	1845	226	0.01	0.01	0.01	17428.			
1	0620	77	0.03	0.03	0.00	47.	*	1	1850	227	0.01	0.01	0.01	17454.			
1	0625	78	0.03	0.03	0.00	47.	*	1	1855	228	0.01	0.01	0.01	17456.			
1	0630	79	0.03	0.03	0.00	48.	*	1	1900	229	0.01	0.01	0.01	17441.			
1	0635	80	0.03	0.03	0.00	48.	*	1	1905	230	0.01	0.01	0.01	17405.			
1	0640	81	0.03	0.03	0.00	48.	*	1	1910	231	0.01	0.01	0.01	17342.			
1	0645	82	0.03	0.03	0.00	48.	*	1	1915	232	0.01	0.01	0.01	17243.			
1	0650	83	0.03	0.03	0.00	49.	*	1	1920	233	0.01	0.01	0.01	17122.			
1	0655	84	0.03	0.01	0.02	49.	*	1	1925	234	0.01	0.01	0.01	16980.			
1	0700	85	0.03	0.01	0.02	50.	*	1	1930	235	0.01	0.01	0.01	16821.			
1	0705	86	0.03	0.01	0.02	51.	*	1	1935	236	0.01	0.01	0.01	16643.			
1	0710	87	0.03	0.01	0.02	52.	*	1	1940	237	0.01	0.01	0.01	16450.			
1	0715	88	0.03	0.01	0.02	53.	*	1	1945	238	0.01	0.01	0.01	16243.			
1	0720	89	0.03	0.01	0.02	55.	*	1	1950	239	0.01	0.01	0.01	16019.			
1	0725	90	0.03	0.01	0.02	58.	*	1	1955	240	0.01	0.01	0.01	15777.			
1	0730	91	0.03	0.01	0.02	61.	*	1	2000	241	0.01	0.01	0.01	15519.			
1	0735	92	0.03	0.01	0.02	64.	*	1	2005	242	0.01	0.01	0.01	15248.			
1	0740	93	0.03	0.01	0.02	68.	*	1	2010	243	0.01	0.01	0.01	14961.			
1	0745	94	0.03	0.01	0.02	73.	*	1	2015	244	0.01	0.01	0.01	14655.			
1	0750	95	0.03	0.01	0.02	78.	*	1	2020	245	0.01	0.01	0.01	14333.			
1	0755	96	0.03	0.01	0.02	84.	*	1	2025	246	0.01	0.01	0.01	13999.			
1	0800	97	0.03	0.01	0.02	91.	*	1	2030	247	0.01	0.01	0.01	13652.			
1	0805	98	0.03	0.01	0.02	98.	*	1	2035	248	0.01	0.01	0.01	13290.			
1	0810	99	0.03	0.01	0.02	106.	*	1	2040	249	0.01	0.01	0.01	12918.			
1	0815	100	0.03	0.01	0.02	116.	*	1	2045	250	0.01	0.01	0.01	12543.			
1	0820	101	0.03	0.01	0.02	126.	*	1	2050	251	0.01	0.01	0.01	12169.			
1	0825	102	0.03	0.01	0.02	137.	*	1	2055	252	0.01	0.01	0.01	11802.			
1	0830	103	0.03	0.01	0.02	150.	*	1	2100	253	0.01	0.01	0.01	11439.			
1	0835	104	0.03	0.01	0.02	163.	*	1	2105	254	0.01	0.01	0.01	11080.			
1	0840	105	0.03	0.01	0.02	178.	*	1	2110	255	0.01	0.01	0.01	10731.			
1	0845	106	0.03	0.01	0.02	193.	*	1	2115	256	0.01	0.01	0.01	10396.			
1	0850	107	0.03	0.01	0.02	210.	*	1	2120	257	0.01	0.01	0.01	10067.			
1	0855	108	0.03	0.01	0.02	228.	*	1	2125	258	0.01	0.01	0.01	9744.			
1	0900	109	0.03	0.01	0.02	247.	*	1	2130	259	0.01	0.01	0.01	9426.			
1	0905	110	0.03	0.01	0.02	267.	*	1	2135	260	0.01	0.01	0.01	9115.			
1	0910	111	0.03	0.01	0.02	288.	*	1	2140	261	0.01	0.01	0.01	8807.			
1	0915	112	0.03	0.01	0.02	310.	*	1	2145	262	0.01	0.01	0.01	8506.			
1	0920	113	0.03	0.01	0.02	332.	*	1	2150	263	0.01	0.01	0.01	8211.			
1	0925	114	0.03	0.01	0.02	355.	*	1	2155	264	0.01	0.01	0.01	7926.			
1	0930	115	0.03	0.01	0.02	379.	*	1	2200	265	0.01	0.01	0.01	7647.			
1	0935	116	0.03	0.01	0.02	403.	*	1	2205	266	0.01	0.01	0.01	7375.			
1	0940	117	0.03	0.01	0.02	428.	*	1	2210	267	0.01	0.01	0.01	7112.			
1	0945	118	0.03	0.01	0.02	453.	*	1	2215	268	0.01	0.01	0.01	6860.			
1	0950	119	0.03	0.01	0.02	478.	*	1	2220	269	0.01	0.01	0.01	6617.			
1	0955	120	0.03	0.01	0.02	504.	*	1	2225	270	0.01	0.01	0.01	6379.			
1	1000	121	0.03	0.01	0.02	529.	*	1	2230	271	0.01	0.01	0.01	6147.			
1	1005	122	0.03	0.01	0.02	555.	*	1	2235	272	0.01	0.01	0.01	5921.			
1	1010	123	0.03	0.01	0.02	580.	*	1	2240	273	0.01	0.01	0.01	5700.			
1	1015	124	0.03	0.01	0.02	606.	*	1	2245	274	0.01	0.01	0.01	5486.			
1	1020	125	0.03	0.01	0.02	631.	*	1	2250	275	0.01	0.01	0.01	5278.			
1	1025	126	0.03	0.01	0.02	657.	*	1	2255	276	0.01	0.01	0.01	5079.			
1	1030	127	0.03	0.01	0.02	682.	*	1	2300	277	0.01	0.01	0.01	4888.			
1	1035	128	0.03	0.01	0.02	707.	*	1	2305	278	0.01	0.01	0.01	4703.			

1	1140	141	0.03	0.01	0.02	992.	*	2	0010	291	0.0	0.0	0.0	[illegible]
1	1145	142	0.03	0.01	0.02	1010.	*	2	0015	292	0.0	0.0	0.0	[illegible]
1	1150	143	0.03	0.01	0.02	1027.	*	2	0020	293	0.0	0.0	0.0	2745.
1	1155	144	0.03	0.01	0.02	1044.	*	2	0025	294	0.0	0.0	0.0	2643.
1	1200	145	0.03	0.01	0.02	1060.	*	2	0030	295	0.0	0.0	0.0	2544.
1	1205	146	0.17	0.01	0.17	1077.	*	2	0035	296	0.0	0.0	0.0	2455.
1	1210	147	0.17	0.01	0.17	1094.	*	2	0040	297	0.0	0.0	0.0	2369.
1	1215	148	0.17	0.01	0.17	1111.	*	2	0045	298	0.0	0.0	0.0	2276.
1	1220	149	0.17	0.01	0.17	1129.	*	2	0050	299	0.0	0.0	0.0	2206.
1	1225	150	0.17	0.01	0.17	1149.	*	2	0055	300	0.0	0.0	0.0	2129.
							*			SUM	24.80	2.57	22.23	

****

; FLOW (FS)	TIME (HR)		6-HR	MAXIMUM AVERAGE FLOW 24-HR	72-HR	24.92-HR
7456.	18.92	(CFS)	13378.	4457.	4294.	4294.
		(INCHES)	16.153	21.529	21.533	21.533
		(AC-FT)	6634.	8841.	8843.	8843.

CUMULATIVE AREA = 7.70 SQ MI

HYDROGRAPH AT STATION A1
PLAN 1. RATIO = 0.50

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	12.	1		0615	76	23.	1		1230	151	586.	1		1845	226	8714.
1		0005	2	12.	1		0620	77	24.	1		1235	152	590.	1		1850	227	8727.
1		0010	3	12.	1		0625	78	24.	1		1240	153	611.	1		1855	228	8728.
1		0015	4	12.	1		0630	79	24.	1		1245	154	626.	1		1900	229	8720.
1		0020	5	12.	1		0635	80	24.	1		1250	155	643.	1		1905	230	8703.
1		0025	6	12.	1		0640	81	24.	1		1255	156	661.	1		1910	231	8671.
1		0030	7	12.	1		0645	82	24.	1		1300	157	681.	1		1915	232	8622.
1		0035	8	12.	1		0650	83	24.	1		1305	158	703.	1		1920	233	8561.
1		0040	9	12.	1		0655	84	25.	1		1310	159	727.	1		1925	234	8490.
1		0045	10	12.	1		0700	85	25.	1		1315	160	754.	1		1930	235	8410.
1		0050	11	12.	1		0705	86	25.	1		1320	161	783.	1		1935	236	8322.
1		0055	12	12.	1		0710	87	26.	1		1325	162	816.	1		1940	237	8225.
1		0100	13	12.	1		0715	88	27.	1		1330	163	852.	1		1945	238	8121.
1		0105	14	12.	1		0720	89	28.	1		1335	164	891.	1		1950	239	8009.
1		0110	15	12.	1		0725	90	29.	1		1340	165	934.	1		1955	240	7888.
1		0115	16	12.	1		0730	91	30.	1		1345	166	981.	1		2000	241	7760.
1		0120	17	12.	1		0735	92	32.	1		1350	167	1031.	1		2005	242	7624.
1		0125	18	12.	1		0740	93	34.	1		1355	168	1086.	1		2010	243	7481.
1		0130	19	12.	1		0745	94	36.	1		1400	169	1145.	1		2015	244	7327.
1		0135	20	12.	1		0750	95	39.	1		1405	170	1208.	1		2020	245	7166.
1		0140	21	13.	1		0755	96	42.	1		1410	171	1275.	1		2025	246	6999.
1		0145	22	13.	1		0800	97	45.	1		1415	172	1346.	1		2030	247	6826.
1		0150	23	13.	1		0805	98	49.	1		1420	173	1421.	1		2035	248	6645.
1		0155	24	13.	1		0810	99	53.	1		1425	174	1499.	1		2040	249	6459.
1		0200	25	13.	1		0815	100	58.	1		1430	175	1580.	1		2045	250	6271.
1		0205	26	13.	1		0820	101	63.	1		1435	176	1665.	1		2050	251	6085.
1		0210	27	14.	1		0825	102	69.	1		1440	177	1753.	1		2055	252	5901.
1		0215	28	14.	1		0830	103	75.	1		1445	178	1844.	1		2100	253	5719.
1		0220	29	14.	1		0835	104	81.	1		1450	179	1938.	1		2105	254	5540.
1		0225	30	14.	1		0840	105	89.	1		1455	180	2034.	1		2110	255	5365.
1		0230	31	14.	1		0845	106	97.	1		1500	181	2133.	1		2115	256	5196.
1		0235	32	15.	1		0850	107	105.	1		1505	182	2234.	1		2120	257	5033.
1		0240	33	15.	1		0855	108	114.	1		1510	183	2337.	1		2125	258	4872.
1		0245	34	15.	1		0900	109	124.	1		1515	184	2442.	1		2130	259	4713.
1		0250	35	15.	1		0905	110	134.	1		1520	185	2550.	1		2135	260	4557.
1		0255	36	16.	1		0910	111	144.	1		1525	186	2661.	1		2140	261	4404.
1		0300	37	16.	1		0915	112	155.	1		1530	187	2775.	1		2145	262	4253.
1		0305	38	16.	1		0920	113	166.	1		1535	188	2906.	1		2150	263	4106.
1		0310	39	16.	1		0925	114	178.	1		1540	189	3038.	1		2155	264	3963.
1		0315	40	17.	1		0930	115	190.	1		1545	190	3174.	1		2200	265	3823.
1		0320	41	17.	1		0935	116	202.	1		1550	191	3318.	1		2205	266	3687.
1		0325	42	17.	1		0940	117	214.	1		1555	192	3473.	1		2210	267	3556.
1		0330	43	17.	1		0945	118	227.	1		1600	193	3632.	1		2215	268	3430.
1		0335	44	18.	1		0950	119	239.	1		1605	194	3793.	1		2220	269	3308.
1		0340	45	18.	1		0955	120	252.	1		1610	195	3959.	1		2225	270	3190.
1		0345	46	18.	1		1000	121	265.	1		1615	196	4130.	1		2230	271	3074.
1		0350	47	18.	1		1005	122	277.	1		1620	197	4303.	1		2235	272	2961.
1		0355	48	19.	1		1010	123	290.	1		1625	198	4478.	1		2240	273	2850.
1		0400	49	19.	1		1015	124	303.	1		1630	199	4657.	1		2245	274	2743.
1		0405	50	19.	1		1020	125	316.	1		1635	200	4844.	1		2250	275	2639.
1		0410	51	19.	1		1025	126	328.	1		1640	201	5032.	1		2255	276	2540.
1		0415	52	20.	1		1030	127	341.	1		1645	202	5223.	1		2300	277	2444.

1	0420	53	20.	*	1	1035	128	354.	*	1	1650	203	5419.	*	1	2305	278	2341.	
1	0425	54	20.	*	1	1040	129	366.	*	1	1655	204	5623.	*	1	2310	279	2261.	
1	0430	55	20.	*	1	1045	130	378.	*	1	1700	205	5829.	*	1	2315	280	2177.	
1	0435	56	21.	*	1	1050	131	390.	*	1	1705	206	6036.	*	1	2320	281	2095.	
1	0440	57	21.	*	1	1055	132	402.	*	1	1710	207	6245.	*	1	2325	282	2017.	
1	0445	58	21.	*	1	1100	133	413.	*	1	1715	208	6458.	*	1	2330	283	1942.	
1	0450	59	21.	*	1	1105	134	424.	*	1	1720	209	6669.	*	1	2335	284	1873.	
1	0455	60	21.	*	1	1110	135	435.	*	1	1725	210	6877.	*	1	2340	285	1807.	
1	0500	61	22.	*	1	1115	136	446.	*	1	1730	211	7077.	*	1	2345	286	1744.	
1	0505	62	22.	*	1	1120	137	457.	*	1	1735	212	7266.	*	1	2350	287	1683.	
1	0510	63	22.	*	1	1125	138	467.	*	1	1740	213	7447.	*	1	2355	288	1624.	
1	0515	64	22.	*	1	1130	139	477.	*	1	1745	214	7621.	*	2	0000	289	1567.	
1	0520	65	22.	*	1	1135	140	487.	*	1	1750	215	7782.	*	2	0005	290	1513.	
1	0525	66	22.	*	1	1140	141	496.	*	1	1755	216	7928.	*	2	0010	291	1460.	
1	0530	67	22.	*	1	1145	142	505.	*	1	1800	217	8063.	*	2	0015	292	1410.	
1	0535	68	23.	*	1	1150	143	514.	*	1	1805	218	8189.	*	2	0020	293	1362.	
1	0540	69	23.	*	1	1155	144	522.	*	1	1810	219	8302.	*	2	0025	294	1316.	
1	0545	70	23.	*	1	1200	145	530.	*	1	1815	220	8397.	*	2	0030	295	1272.	
1	0550	71	23.	*	1	1205	146	538.	*	1	1820	221	8482.	*	2	0035	296	1227.	
1	0555	72	23.	*	1	1210	147	547.	*	1	1825	222	8550.	*	2	0040	297	1185.	
1	0600	73	23.	*	1	1215	148	555.	*	1	1830	223	8617.	*	2	0045	298	1143.	
1	0605	74	23.	*	1	1220	149	564.	*	1	1835	224	8660.	*	2	0050	299	1103.	
1	0610	75	23.	*	1	1225	150	575.	*	1	1840	225	8692.	*	2	0055	300	1064.	

EAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	24.92-HR
8726.	18.92	(CFS)	6689.	2229.	2147.	2147.
		(INCHES)	8.077	10.765	10.767	10.767
		(AC-FT)	3317.	4421.	4422.	4422.

CUMULATIVE AREA = 7.70 SQ MI

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14 KK          A2          ROUTE INFLOW HYDROGRAPH THROUGH HOPE LAKE

   HYDROGRAPH ROUTING DATA

15 RS      STORAGE ROUTING
                NSTPS       1  NUMBER OF SUBREACHES
                ITYP     STOR  TYPE OF INITIAL CONDITION
              RSVRIC    64.00  INITIAL CONDITION
                   X     0.0  WORKING R AND D COEFFICIENT

16 SV        STORAGE       0.0      64.0      70.0     100.0     150.0     180.0     210.0     350.0     520.0     850.0

17 SE        ELEVATION   417.40    424.70    425.20    426.00    426.70    427.20    427.70    428.70    430.00    432.00

18 SQ        DISCHARGE       0.        0.       57.      337.      846.     1464.     2168.     4133.     7442.    13216.

19 SE        ELEVATION   417.40    424.70    425.20    426.00    426.70    427.20    427.70    428.70    430.00    432.00

20 SS        SPILLWAY
                CREL      424.70  SPILLWAY CREST ELEVATION
               SPWID       60.00  SPILLWAY WIDTH
                COOW        2.70  WEIR COEFFICIENT
                EXPW        1.50  EXPONENT OF HEAD

21 ST        TOP OF DAM
               TOPEL      426.00  ELEVATION AT TOP OF DAM
              DAMWID      173.00  DAM WIDTH
                COOD         0.0  WEIR COEFFICIENT
                EXPD        1.50  EXPONENT OF HEAD

                                                ***
                                  COMPUTED STORAGE-OUTFLOW CURVE
   STORAGE       0.0      64.00     70.00    100.00    150.00    180.00    210.00    350.00    520.00    850.00

   OUTFLOW       0.0       0.0      57.00    337.00    846.00   1464.00   2188.00   4133.00   7442.00  13216.00
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HYDROGRAPH AT STATION A2
PLAN 1, RATIO = 0.50

HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
0000	1	0.	64.0	424.7	1		0820	101	34.	67.5	425.0	1		1640	201	3573.	309.7	428.4
0005	2	1.	64.1	424.7	1		0825	102	36.	67.7	425.0	1		1645	202	3715.	319.9	428.5
0010	3	1.	64.1	424.7	1		0830	103	38.	68.0	425.0	1		1650	203	3861.	330.4	428.6
0015	4	2.	64.2	424.7	1		0835	104	40.	68.2	425.1	1		1655	204	4012.	341.3	428.6
0020	5	3.	64.3	424.7	1		0840	105	43.	68.5	425.1	1		1700	205	4172.	352.5	428.7
0025	6	3.	64.3	424.7	1		0845	106	46.	68.9	425.1	1		1705	206	4401.	363.8	428.8
0030	7	4.	64.4	424.7	1		0850	107	50.	69.2	425.1	1		1710	207	4626.	375.0	428.9
0035	8	4.	64.4	424.7	1		0855	108	53.	69.6	425.2	1		1715	208	4837.	384.2	429.0
0040	9	5.	64.5	424.7	1		0900	109	57.	70.0	425.2	1		1720	209	5033.	397.3	429.1
0045	10	5.	64.5	424.7	1		0905	110	62.	70.5	425.2	1		1725	210	5269.	408.4	429.1
0050	11	5.	64.6	424.7	1		0910	111	66.	71.0	425.2	1		1730	211	5473.	419.4	429.2
0055	12	6.	64.6	424.8	1		0915	112	72.	71.6	425.2	1		1735	212	5695.	430.3	429.3
0100	13	6.	64.7	424.8	1		0920	113	77.	72.2	425.3	1		1740	213	5903.	441.0	429.4
0105	14	7.	64.7	424.8	1		0925	114	83.	72.8	425.3	1		1745	214	6108.	451.5	429.5
0110	15	7.	64.7	424.8	1		0930	115	89.	73.5	425.3	1		1750	215	6308.	461.7	429.6
0115	16	7.	64.8	424.8	1		0935	116	96.	74.2	425.3	1		1755	216	6502.	471.7	429.6
0120	17	7.	64.8	424.8	1		0940	117	103.	74.9	425.3	1		1900	217	6688.	481.3	429.7
0125	18	8.	64.8	424.8	1		0945	118	110.	75.7	425.4	1		1805	218	6869.	490.6	429.8
0130	19	8.	64.8	424.8	1		0950	119	118.	76.5	425.4	1		1810	219	7042.	499.4	429.8
0135	20	8.	64.9	424.8	1		0955	120	126.	77.3	425.4	1		1815	220	7206.	507.9	429.9
0140	21	8.	64.9	424.8	1		1000	121	134.	78.2	425.4	1		1820	221	7361.	515.8	430.0
0145	22	9.	64.9	424.8	1		1005	122	142.	79.1	425.4	1		1825	222	7508.	523.3	430.0
0150	23	9.	64.9	424.8	1		1010	123	151.	80.1	425.5	1		1830	223	7643.	530.4	430.1
0155	24	9.	65.0	424.8	1		1015	124	160.	81.0	425.5	1		1835	224	7738.	536.9	430.1
0200	25	9.	65.0	424.8	1		1020	125	169.	82.0	425.5	1		1840	225	7844.	543.0	430.1
0205	26	10.	65.0	424.8	1		1025	126	179.	83.1	425.5	1		1845	226	7942.	548.6	430.2
0210	27	10.	65.0	424.8	1		1030	127	188.	84.1	425.6	1		1850	227	8030.	553.6	430.2
0215	28	10.	65.1	424.8	1		1035	128	198.	85.1	425.6	1		1855	228	8109.	558.1	430.2
0220	29	10.	65.1	424.8	1		1040	129	208.	86.2	425.6	1		1900	229	8179.	562.1	430.2
0225	30	11.	65.1	424.8	1		1045	130	218.	87.3	425.7	1		1905	230	8238.	565.5	430.3
0230	31	11.	65.1	424.8	1		1050	131	229.	88.4	425.7	1		1910	231	8289.	568.4	430.3
0235	32	11.	65.2	424.8	1		1055	132	239.	89.5	425.7	1		1915	232	8329.	570.7	430.3
0240	33	11.	65.2	424.8	1		1100	133	250.	90.6	425.7	1		1920	233	8359.	572.4	430.3
0245	34	11.	65.2	424.8	1		1105	134	260.	91.7	425.8	1		1925	234	8377.	573.5	430.3
0250	35	12.	65.2	424.8	1		1110	135	270.	92.9	425.8	1		1930	235	8385.	573.9	430.3
0255	36	12.	65.2	424.8	1		1115	136	281.	94.0	425.8	1		1935	236	8382.	573.7	430.3
0300	37	12.	65.3	424.8	1		1120	137	291.	95.1	425.9	1		1940	237	8370.	573.0	430.3
0305	38	12.	65.3	424.8	1		1125	138	302.	96.2	425.9	1		1945	238	8347.	571.7	430.3
0310	39	13.	65.3	424.8	1		1130	139	312.	97.4	425.9	1		1950	239	8315.	569.9	430.3
0315	40	13.	65.3	424.8	1		1135	140	323.	98.5	426.0	1		1955	240	8273.	567.5	430.3
0320	41	13.	65.4	424.8	1		1140	141	333.	99.6	426.0	1		2000	241	8222.	564.6	430.3
0325	42	13.	65.4	424.8	1		1145	142	344.	100.7	426.0	1		2005	242	8161.	561.1	430.2
0330	43	13.	65.4	424.8	1		1150	143	355.	101.8	426.0	1		2010	243	8091.	557.1	430.2
0335	44	14.	65.4	424.8	1		1155	144	366.	102.9	426.0	1		2015	244	8013.	552.6	430.2
0340	45	14.	65.5	424.8	1		1200	145	377.	103.9	426.1	1		2020	245	7926.	547.6	430.2
0345	46	14.	65.5	424.8	1		1205	146	387.	105.0	426.1	1		2025	246	7830.	542.2	430.1
0350	47	14.	65.5	424.8	1		1210	147	398.	106.0	426.1	1		2030	247	7725.	536.2	430.1
0355	48	15.	65.5	424.8	1		1215	148	408.	107.0	426.1	1		2035	248	7613.	529.7	430.1
0400	49	15.	65.6	424.8	1		1220	149	418.	108.0	426.1	1		2040	249	7492.	522.9	430.0
0405	50	15.	65.6	424.8	1		1225	150	428.	109.0	426.1	1		2045	250	7356.	515.6	430.0
0410	51	15.	65.6	424.8	1		1230	151	439.	110.0	426.1	1		2050	251	7207.	507.9	429.9
0415	52	16.	65.6	424.8	1		1235	152	449.	111.0	426.2	1		2055	252	7054.	500.1	429.8
0420	53	16.	65.7	424.8	1		1240	153	459.	112.0	426.2	1		2100	253	6896.	492.0	429.8
0425	54	16.	65.7	424.8	1		1245	154	470.	113.1	426.2	1		2105	254	6738.	483.8	429.7
0430	55	16.	65.7	424.8	1		1250	155	481.	114.1	426.2	1		2110	255	6576.	475.5	429.7
0435	56	17.	65.7	424.8	1		1255	156	493.	115.3	426.2	1		2115	256	6414.	467.2	429.6
0440	57	17.	65.8	424.8	1		1300	157	505.	116.5	426.2	1		2120	257	6250.	458.8	429.5
0445	58	17.	65.8	424.8	1		1305	158	517.	117.7	426.2	1		2125	258	6087.	450.4	429.5

1	0510	59	17.	65.8	424.9	*	1	1310	157	531.	119.0	426.3	*	1	2150	259	5224.	442.0	429.4
1	0515	60	17.	65.8	424.9	*	1	1315	160	545.	120.4	426.3	*	1	2135	260	5782.	433.7	429.3
1	0520	61	18.	65.9	424.9	*	1	1320	161	560.	121.9	426.3	*	1	2140	261	5661.	425.4	429.3
1	0525	62	18.	65.9	424.9	*	1	1325	162	576.	123.5	426.3	*	1	2145	262	5440.	417.2	429.2
1	0530	63	18.	65.9	424.9	*	1	1330	163	593.	125.2	426.4	*	1	2150	263	5202.	409.0	429.2
1	0535	64	18.	65.9	424.9	*	1	1335	164	612.	127.0	426.4	*	1	2155	264	5125.	401.0	429.1
1	0540	65	19.	65.9	424.9	*	1	1340	165	632.	129.0	426.4	*	1	2200	265	4970.	393.0	429.0
1	0545	66	19.	66.0	424.9	*	1	1345	166	654.	131.2	426.4	*	1	2205	266	4817.	385.1	429.0
1	0550	67	19.	66.0	424.9	*	1	1350	167	678.	133.5	426.5	*	1	2210	267	4667.	377.4	428.9
1	0555	68	19.	66.0	424.9	*	1	1355	168	704.	136.0	426.5	*	1	2215	268	4519.	369.8	428.9
1	0600	69	19.	66.0	424.9	*	1	1400	169	732.	138.8	426.5	*	1	2220	269	4374.	362.4	428.8
1	0605	70	19.	66.1	424.9	*	1	1405	170	762.	141.7	426.6	*	1	2225	270	4232.	355.1	428.7
1	0610	71	20.	66.1	424.9	*	1	1410	171	794.	144.9	426.6	*	1	2230	271	4105.	347.9	428.7
1	0615	72	20.	66.1	424.9	*	1	1415	172	829.	148.3	426.7	*	1	2235	272	4005.	340.8	428.6
1	0620	73	20.	66.1	424.9	*	1	1420	173	866.	152.0	426.7	*	1	2240	273	3904.	333.5	428.6
1	0625	74	20.	66.1	424.9	*	1	1425	174	962.	155.6	426.8	*	1	2245	274	3803.	326.2	428.5
1	0630	75	20.	66.1	424.9	*	1	1430	175	1039.	159.3	426.9	*	1	2250	275	3701.	318.9	428.5
1	0635	76	21.	66.2	424.9	*	1	1435	176	1116.	163.1	426.9	*	1	2255	276	3600.	311.6	428.4
1	0640	77	21.	66.2	424.9	*	1	1440	177	1194.	166.9	427.0	*	1	2300	277	3499.	304.3	428.4
1	0645	78	21.	66.2	424.9	*	1	1445	178	1274.	170.8	427.0	*	1	2305	278	3398.	297.1	428.3
1	0650	79	21.	66.2	424.9	*	1	1450	179	1356.	174.7	427.1	*	1	2310	279	3298.	289.9	428.3
1	0655	80	21.	66.2	424.9	*	1	1455	180	1439.	178.8	427.2	*	1	2315	280	3199.	282.8	428.2
1	0700	81	21.	66.2	424.9	*	1	1500	181	1534.	182.9	427.2	*	1	2320	281	3102.	275.8	428.2
1	0705	82	21.	66.3	424.9	*	1	1505	182	1633.	187.0	427.3	*	1	2325	282	3006.	268.9	428.1
1	0710	83	22.	66.3	424.9	*	1	1510	183	1733.	191.1	427.4	*	1	2330	283	2912.	262.1	428.1
1	0715	84	22.	66.3	424.9	*	1	1515	184	1833.	195.3	427.5	*	1	2335	284	2820.	255.5	428.0
1	0720	85	22.	66.3	424.9	*	1	1520	185	1935.	199.5	427.5	*	1	2340	285	2730.	249.0	428.0
1	0725	86	22.	66.3	424.9	*	1	1525	186	2037.	203.7	427.6	*	1	2345	286	2643.	242.7	427.9
1	0730	87	22.	66.3	424.9	*	1	1530	187	2141.	208.1	427.7	*	1	2350	287	2558.	236.6	427.9
1	0735	88	22.	66.4	424.9	*	1	1535	188	2224.	212.6	427.7	*	1	2355	288	2475.	230.7	427.8
1	0740	89	23.	66.4	424.9	*	1	1540	189	2292.	217.5	427.8	*	2	0000	289	2395.	224.9	427.8
1	0745	90	23.	66.4	424.9	*	1	1545	190	2366.	222.6	427.8	*	2	0005	290	2316.	219.2	427.8
1	0750	91	23.	66.5	424.9	*	1	1550	191	2446.	228.6	427.8	*	2	0010	291	2240.	213.8	427.7
1	0755	92	24.	66.5	424.9	*	1	1555	192	2533.	234.8	427.9	*	2	0015	292	2167.	208.5	427.7
1	0740	93	24.	66.6	424.9	*	1	1600	193	2626.	241.5	427.9	*	2	0020	293	2054.	203.6	427.6
1	0745	94	25.	66.6	424.9	*	1	1605	194	2725.	248.6	428.0	*	2	0025	294	1927.	199.2	427.5
1	0750	95	26.	66.7	424.9	*	1	1610	195	2830.	256.2	428.0	*	2	0030	295	1830.	195.2	427.5
1	0755	96	27.	66.8	424.9	*	1	1615	196	2940.	264.1	428.1	*	2	0035	296	1741.	191.5	427.4
1	0800	97	28.	66.9	424.9	*	1	1620	197	3057.	272.5	428.1	*	2	0040	297	1659.	188.1	427.3
1	0805	98	29.	67.0	425.0	*	1	1625	198	3178.	281.3	428.2	*	2	0045	298	1583.	184.9	427.3
1	0810	99	30.	67.2	425.0	*	1	1630	199	3305.	290.4	428.3	*	2	0050	299	1512.	182.0	427.2
1	0815	100	32.	67.3	425.0	*	1	1635	200	3436.	299.9	428.3	*	2	0055	300	1449.	179.3	427.2

****

PEAK OUTFLOW IS 6365. AT TIME 19.50 HOURS

PEAK FLOW (CFS)	TIME (HR)		6-HR	MAXIMUM AVERAGE FLOW 24-HR	72-HR	24.92-HR
6365.	19.50	(CFS)	6530.	2169.	2090.	2090.
		(INCHES)	1.885	10.478	10.479	10.479
		(AC-FT)	3238.	4303.	4303.	4303.

PEAK STORAGE (AC-FT)	TIME (HR)	6-HR	MAXIMUM AVERAGE STORAGE 24-HR	72-HR	24.92-HR
574.	19.50	474.	207.	202.	202.

PEAK STAGE (FEET)	TIME (HR)	6-HR	MAXIMUM AVERAGE STAGE 24-HR	72-HR	24.92-HR
[illegible]	[illegible]	429.62	426.82	426.74	426.74

CUMULATIVE AREA = 7.70 SQ MI

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO FLOWS RATIO 1 0.10	 RATIO 2 0.25	 RATIO 3 0.50
HYDROGRAPH AT	A1	7.70	1	FLOW	1746.	4364.	8728.
				TIME	18.92	18.92	18.92
ROUTED TO	A2	7.70	1	FLOW	1696.	4107.	8385.
				TIME	19.42	19.67	19.50
			** PEAK STAGES IN FEET **				
			1	STAGE	427.36	428.69	430.33
				TIME	19.42	19.67	19.50

SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION A2

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	424.70	424.70	426.00
STORAGE	64.	64.	100.
OUTFLOW	0.	0.	337.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.10	427.36	1.36	190.	1696.	9.42	19.42	0.0
0.25	428.69	2.69	348.	4107.	11.08	19.67	0.0
0.50	430.33	4.33	574.	8385.	13.25	19.50	0.0

*** NORMAL END OF JOB ***

APPENDIX 5
REFERENCES

HOPE LAKE DAM

APPENDIX 5
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Chow, Ven Te, Open Channel Hydraulics, McGraw Hill Book Company, New York, 1959.

King, H.W. and E.F. Brater, Handbook of Hydraulics, McGraw Hill Book Company, New York, Fifth Edition 1963.

Kummel, H.B. and Peet Glacial Drift Map of New Jersey, 1902.

Lewis, J.V. and H.B. Kummel (1910-1912) Geologic Map of New Jersey, revised by H.B. Kummel, 1931, and by M.E. Johnson, 1950. New Jersey Department of Conservation of Economic Development Atlas.

Schway, G.O., R.K. Frevert, T.W. Edmister, and K.K. Barnes, Soil and Water Conservation Engineering, The Ferguson Foundation Agricultural Engineering Series, John Wiley and Sons, Inc., New York, 1966, 683 pp.

U.S. Army Corps of Engineers, Hydrologic Engineering Center, Flood Hydrograph Package (HEC-1) Users Manual Preliminary, Davis, California, March 1981.

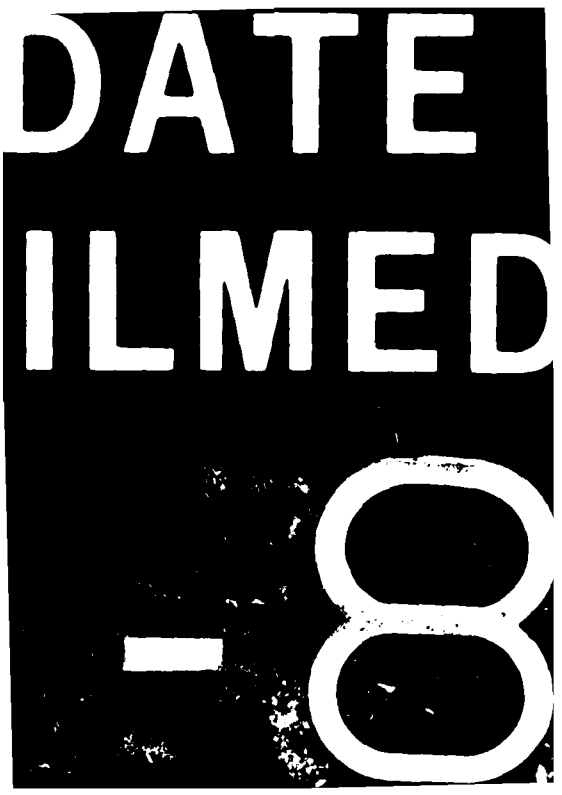
U.S. Department of Agriculture, Soil Conservation Service, Urban Hydrology for Small Watersheds, Technical Release No. 55, Washington, 1975.

U.S. Department of Commerce, Weather Bureau, "Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1000 Square Miles and Durations of 6, 12, 24, and 48 Hours", Hydrometeorological Report No. 33, Washington, 1977, 816 pp.

United States Department of Interior, Bureau of Reclamation, Design of Small Dams, U.S. Government Printing Office, Washington, 1977, 816 pp.

U.S. Department of Interior, Geological Survey, 7.5-Minute Series (topographic) maps, scale 1:24000, Contour Interval 20 feet: Blairstown, New Jersey, (1957), Photorevised 1971.

Viessman, Warren, Jr., J.W. Knapp, G.L. Lewis, T.E. Harbaugh, Introduction to Hydrology, Harper and Row, Publishers, New York, Second Edition 1977, 704 pp.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